Sensitivity of Multi Turn Receiving Loops

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Abstract

Multi turn wire loops are often used as low frequency receiving antennas. Applications such as geophysical research, oil exploration and survivable communications require maximum sensitivity of receiving loop antennas. The loop sensitivity decreases as frequency decreases, becoming a formidable problem below 1 Hz. Basic electromagnetic theory is developed here as it relates to electrically small multi-turn loops at low frequencies. Simple algebraic expressions are produced describing the sensitivity of loops in simple geometries. The concept of antenna factor (effective aperture) is introduced, which allows comparison of different loops, and conversion of observations to common magnetic units of measure. It is hoped this work will be a useful reference to geophysical researchers, and to anyone designing loops for low frequencies.

Introduction

Magnetism is manifested as a 'field of vectors', that is, any point in the magnetic field has not only a magnitude, but a direction in space. The four Maxwell equations describe how electric and magnetic vector fields behave and interact. These "fields" are actually primordial root forces and motions of our spacetime continuum. It is well said that all the laws of physics can be derived from the Maxwell equations, given here in integral form:

(a) $\int_C \mathbf{B} \bullet \mathbf{n}\ da = q_m = 0$ No magnetic monopoles

(b) $\int_C \mathbf{D} \bullet \mathbf{n}\ da = q_e$ Sum of flux is electric charge.

(c) $\int \mathbf{H} \times \mathbf{n}\ da = {}^{\partial}/_{\partial t}\ \mathrm{V}$ Curl of magnetic field due to electric flux change

(d) $\int \mathbf{E} \times \mathbf{n}\ da = {}^{\partial}/_{\partial t}\ \mathrm{I}$ Curl of electric field due to magnetic flux change

According to Maxwell, an electric field cannot change without creating a magnetic field, and a magnetic field cannot change without creating an electric field. Any change in one force field creates a vortex or wake in spacetime appearing as the other aspect of the force. Electromagnetic waves have both electric (E) and magnetic (H) components, and propagate as ripples in the fabric of our continuum. The E and H aspects appear 90 degrees apart in space dimensions and in phase in the time dimension. Loops of wire are often used as antennas to interact with and detect the magnetic aspect of the electromagnetic force.

Suppose we have a varying magnetic field 'out there' which we want to detect and measure. This field may originate naturally or artificially. To make the analysis more tractable, the loop is assumed to be electrically small, the dimensions being much smaller than a wavelength of the frequencies of interest. We also take the distance to the source as being much larger than the loop dimensions. These conditions are usually well satisfied in geophysics. We will use vector calculus to derive from first principles the response of such a loop. Those unfamiliar with this branch of mathematics may skip down to equation (10), where the going gets easier.

Theory of Magnetic Loops

Magnetic field intensity, H, expressed in units of amperes per meter, produces a magnetic flux density , B, expressed in volt seconds per square meter. Flux is proportional to applied field.

(1) $\mathbf{B} = \mu \mathbf{H}$

μ, expressed in Henrys per meter, is the magnetic permeability of the medium, the analog of electric permitivity. We will let μ equal μ_0, the permeability of a vacuum (spacetime itself). This assumption is well justified for air core loops surrounded by non magnetic media, including air, water, dirt, vegetation,

etc.

The total magnetic flux, Φ, in volt-seconds, threading an area is the flux density integrated over the area. The vector **n** denotes a unit vector normal to *da*, the element of the surface being integrated over.

$$\Phi = \int \mathbf{B} \bullet \mathbf{n} \; da \tag{2}$$

Voltage around a loop is proportional to the rate of change of the amount of flux threading the loop area. When multiple turns are in series, the total voltage is the sum of the individual turns.

$$\mathbf{V} = \mathbf{N} \; {}^{d\Phi}/_{dt} \tag{3}$$

Notice from (3) that a motionless loop in a constant dc field produces no voltage. Combining these three equations gives an expression for the terminal voltage of a multiturn wire loop. The vector normal component of the H field is integrated over the loop area, and differentiated by time.

$$\mathbf{V} = \mu_0 \, \mathbf{N} \; {}^{d}/_{dt} \int \mathbf{H} \bullet \mathbf{n} \; da \tag{4}$$

When the H field is uniform over a planar loop, we can take H out of the integral and express its vector normal component as the magnitude times the cosine of the angle between the H vector and the loop axis.

$$\mathbf{V} = \mu_0 \, \mathbf{N} \cos\theta \; {}^{d}/_{dt} \, |\mathbf{H}| \int da \tag{5}$$

and the integral becomes simply the loop area.

$$\mathbf{V} = \mu_0 \, \mathbf{N} \, \mathbf{A} \; \cos\theta \; {}^{d}/_{dt} \, |\mathbf{H}| \tag{6}$$

Most of the calculus is solved, but the time derivative of H remains. We can reduce it to simple algebra by examining a discrete frequency (ωt) component of H, with peak amplitude H0.

$$(7) \qquad H = H_0 \ \sin(\omega t)$$

Which transforms equation (6) into:

$$(8) \qquad V = \mu_0 \, N \, A \, \cos\theta \ {}^{d}/_{dt} \, (H_0 \sin(\omega t))$$

So we now rid ourselves entirely of calculus:

$$(9) \qquad V = \mu_0 \, N \, A \, \cos\theta \ H_0 \, \omega \cos(\omega t)$$

Taking the magnitude of the signal, we get loop terminal voltage as a straight algebraic product of six terms;

$$(10) \qquad V = 2\pi\mu_0 \ N \ A \ H_0 \ f \ \cos\theta$$

Where:

$2\pi\mu_0$	is a constant.
N	is the number of turns
A	is the loop area, in square meters.
H_0	is the applied magnetic field, in amperes per meter.
f	is the frequency, in Hertz.
$\cos\theta$	is the cosine of the angle between the loop axis and the field.

The persistent product of N and A are the only remaining terms which describe characteristics of the loop itself. This product suggests a figure of merit for loop antennas, the "effective aperture", Ae , which is the physical area times the number of turns.

We can now express the on-axis sensitivity of a loop, which is the terminal voltage divided by the applied magnetic field, as the product of only three terms:

$$(11) \qquad V/H_0 = 2\pi\mu_0 \ f \ A_e$$

Where:

V/H_0	is the output voltage per unit magnetic field strength applied
$2\pi\mu_0$	is a constant = 7.89×10^{-6}.
A_e	is the loop effective aperture, in square meters.
f	is the frequency, in Hertz.

Equation (11) clearly shows the problem of loops at low frequencies: as f approaches zero, so does the loop voltage! Although we can't do much to change 2π, we might try increasing μ above μ_0 by using a ferrite loop core, but this becomes impractical with large areas. Our only recourse is to increase the effective aperture.

Effective Aperture

We now have a rigorously derived expression for loop antenna sensitivity, reduced to the simple product of three terms, a constant, the frequency, and the effective aperture, which is the antenna factor. By knowing the effective aperture, we can relate the loop output back to the magnetic field strength. We can also compare the sensitivities of different loops, making possible the correlation of data from researchers using different loops. This effective aperture is simply the loop area times the number of turns, expressed in square meters.

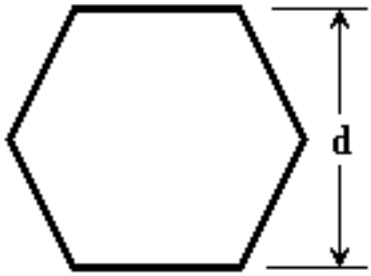
The areas of some common loop geometries are:

SQUARE

$$A = k d^2 = d^2$$

$$k = 1$$

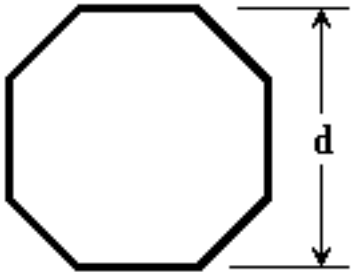
HEXAGON



$$A = k d^2 = .8660\ d^2$$

$$k = \frac{3 \tan(30)}{2}$$

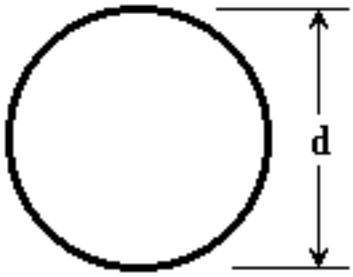
OCTAGON



$$A = k d^2 = .8284\ d^2$$

$$k = \frac{2 + 2\sqrt{2}}{3 + 2\sqrt{2}}$$

CIRCLE



$$A = k d^2 = .7854\ d^2$$

$$k = \frac{\pi}{4}$$

*Maximizing A*e

For maximum sensitivity, we want maximum effective aperture. Practical limitations dictate the effective aperture we can achieve. For example, we might be limited to 5lb loop mass of copper wire, and can handle wire as small as #30 AWG. What is the maximum effective aperture we can achieve?

From the NIST copper wire tables we get: wire diameter = 0.010 in, length = 16435 ft, and resistance = 526 ohms. For a circular loop, the wire length and loop area are:

(12) $$N = l / (\pi d)$$

$$(13) \qquad A = \pi/4 \quad d^2$$

So the antenna sensitivity for a fixed wire length is :

$$(14) \qquad A_e = N\ A = \frac{\lambda\ d}{4}$$

The **d** term appearing in the numerator tells us to deploy a fixed length of wire as a single turn for maximum sensitivity. The diameter will then be :

$$(15) \qquad d = \pi/\lambda \quad = 5230 \text{ ft}$$

With an antenna factor of:

$$(16) \qquad A_e = N\,A = A = 21{,}500{,}000 \text{ ft}^2 = 2{,}000{,}000 \text{ m}^2$$

A large effective aperture, but our trepidation in handling a one mile diameter loop of #30 AWG wire leads us to now limit the loop diameter to ten feet. Equations (12) through (14) give us:

the turns	$N = 523$
the area	$A = 78.5 \text{ ft}^2$
the aperture	$A_e = 41{,}100 \text{ ft}^2$, or about 3800 m^2.

This is a manageable structure, but sensitivity has been reduced 523 times.

Some rules of thumb for loop sensitivity are:

- **For a fixed number of turns:**
  Sensitivity goes up as loop diameter squared, and up as wire length squared.
- **For a fixed wire length:**
  Sensitivity goes up as the loop diameter, and down inversely as the number of turns.
- **For a fixed loop diameter:**
  Sensitivity goes up as number of turns, and up as wire length.

Which shows that "Turns are good, but size is better!" and "Use as much wire as you can!"

Practical Examples And Considerations

The 'octoloop' is an easily built, well shielded, VLF loop, small enough to gimbal, which was my primary design goal. The design files for the 'octoloop' are available here, and on the LWCA BBS. The octoloop characteristics are:

```
A  = 3.42        m^2
N  = 50         turns
Ae = 171         m^2
```

I also built a fixed loop of six pair telephone wire 160 feet in diameter in the backyard:

```
A  = 1865        m^2
N  = 12         turns
Ae = 22,381      m^2
```

Obviously, the fixed loop is more sensitive, by a factor of about 130. In antenna terms, this is a gain increase of about 42 db, a substantial improvement! However, if by gimballing the octoloop, I can get a 50 db deep null in interference, and stay above my receiver noise floor, the octoloop still has an 8 db advantage. On the other hand, with the fixed loop, if I filter out the power grid interference, I can go 130 times lower in frequency before falling below the thermal noise floor.

The octoloop is more useful for sferics and OMEGA reception, but the fixed loop is capable of deep infrasonic frequencies and geomagnetic work. Below some point in the spectrum, one must forego gimballing and portability to gain very large antenna effective apertures. Larry Grant's "Life at 1200 Turns" loop probably has an aperture near Ae = 2000 m^2, approaching the practical limit for portable loops. In oil exploration, loops of several hundred feet of multiconductor cable are transported by rolling them up on spools.

Other Factors

If an electric current flows in the loop, the terminal voltage and the sensitivity will be modified from that derived above. Current may be drawn by resistively loading the loop output, which will decrease the available voltage. Parasitic capacitance, as well as external capacitance will also cause a current flow, but one which is leading in phase. Capacitance neutralizes the lagging phase of the loop inductance and causes a frequency resonance, increasing the aperture while reducing the bandwidth. The magnitude of these tuning effects are maximum when loop resistance is minimum. Capacitively tuned loops are useful for their sensitivity to a single discrete frequency.

Mechanical motion of a conductor in a steady DC field induces a voltage, leading to microphonic effects. Microphonics may be reduced by structural stiffening and damping, to reduce vibrational resonances and shift them out of the frequency bands of interest. Many loop structures will have an axis of minimum vibrational response, which may be aligned with the local field to further reduce microphonics.

Temperature effects in dissimilar metallic junctions cause Seebeck voltages to be produced, which generally have time constants as long or longer than the thermal cycle. Temperature also causes voltage drift in high gain DC coupled amplifiers. Thermal effects may be controlled by isolating amplifiers and metallic junctions from temperature changes, by DC blocking, or by chopper stabilizing DC amplifiers.

Direction of Future Work

The fixed loop was originally intended for OMEGA (the 10 to 14 kHz squeal) reception, but Larry Grant and Bob Confrey have me interested in geomagnetics. Presently, I am working out an improved preamplifier design for geomagnetic frequencies. I am convinced the best way to go is a fixed moderate gain first stage at the loop, using a biomedical instrumentation amplifier such as Analog Devices AD620, and then put more gain with adjustments, filtering, etc in a separate indoor unit. For large aperture loops, the preamp must tolerate very high 60 Hz hum levels without desensing or intermodulation.

Also I am looking for yet more antenna aperture. Just today, I screeched my truck to a halt and leaped into a muddy excavation wearing my good pants because I believed I saw an abandoned length of 600 pair telephone trunk cable. The area of my backyard is about 6300 m^2, which enclosed with 1200 turns (600 pair) would give Ae = 7,500,000 m^2. This would be the most sensitive loop I know how to make here, having three times the aperture of the hypothetical one mile turn of wire discussed above, and should be useful to below 0.01 Hz.

A DC block below 0.001 Hz or so will be required to remove the Seebeck potentials from 1200 spliced joints, and the antenna may be buried to reduce microphonics. I am at a loss for a feasible method of removing seismic microphonics, which I believe will appear as the next envelope boundary, although seismic microphonics may in themselves be a worthwhile study.

Conclusion

The sensitivity of loop antennas at low frequencies has been mathematically derived, and expressed in practical terms. The concept of effective aperture, and how to maximize it has been presented. It is my heartfelt recommendation that researchers calculate and report the effective apertures of the loops they use, and refer their measurements to loop terminal voltage. In this way, all geomagnetic observations can be converted to a common unit of measure.

Acknowledgements

I would like to thank Bob Confrey for sparking my interest in geomagnetics, Larry Grant for his landmark practical design, and Anthony Fraser-Smith for his pioneering work. I also want to thank Dr. John Weaver, Dr. Walter Nunn, and L.A. (Kip) Turner for mentoring and inspiring me throughout the years.

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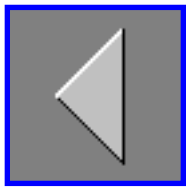
 Return to Receiving Equipment Library.

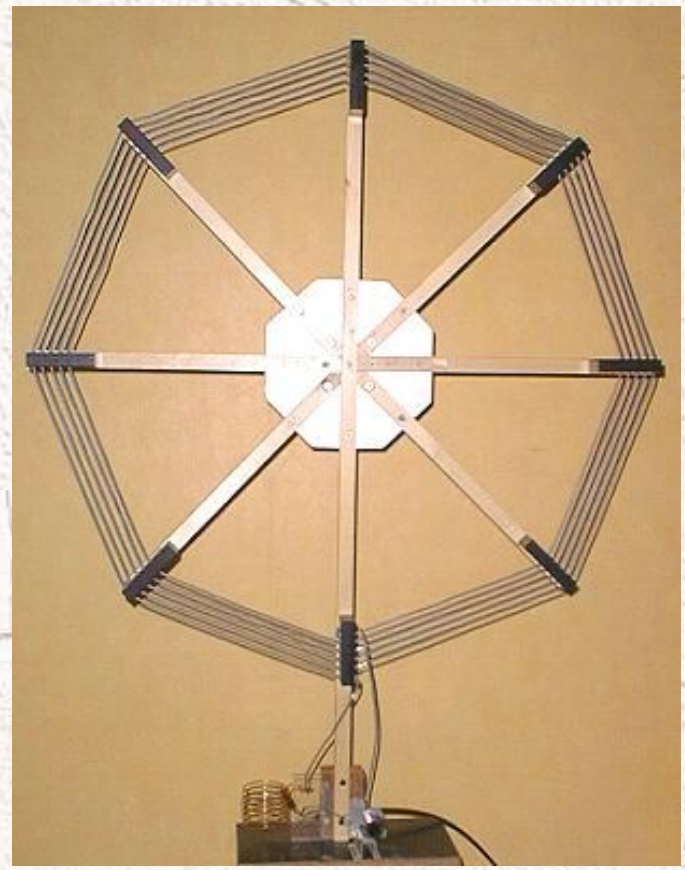
Go to Longwave Home Page.

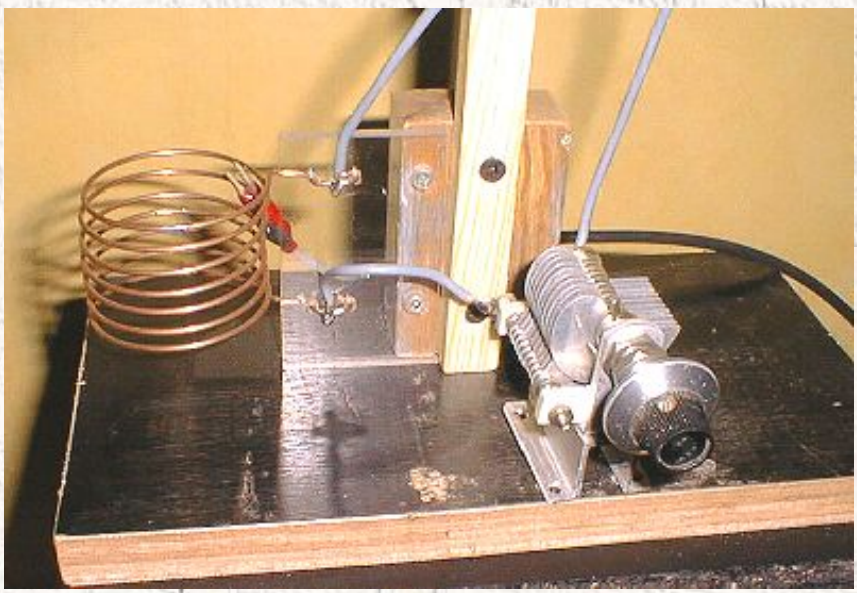
Magnetic Loop Antenna's.

Why is an Magnetic Loop antenna so special, this antenna is picking only the MAGNETIC part of the ELEKTRO MAGNETIC radio wave. The big advantage of this antenna is that the electric interference from the big city (streetlights, television's , cars etc...) have no influence on the received signal. With the loop you can hear other stations that you can't hear if you use a DIPOLE, with a dipole the stations are buried in the noise.

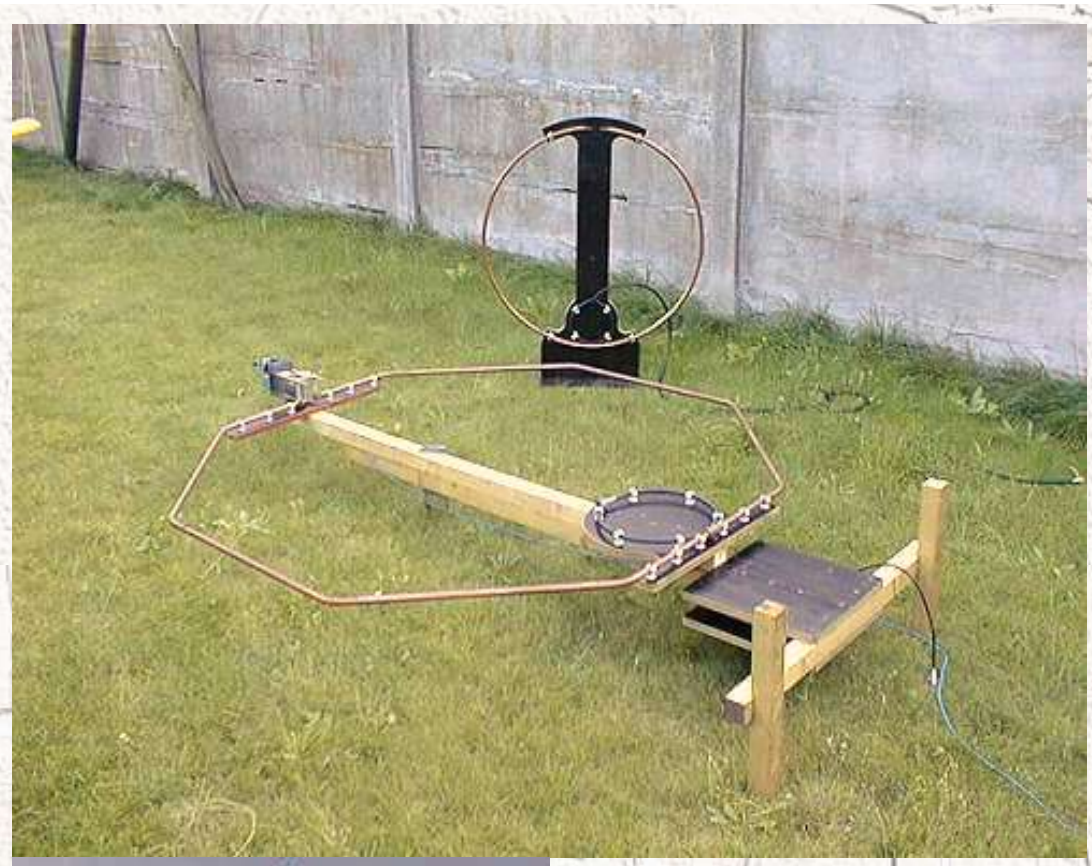
Multi Turn Magnetic Loop.

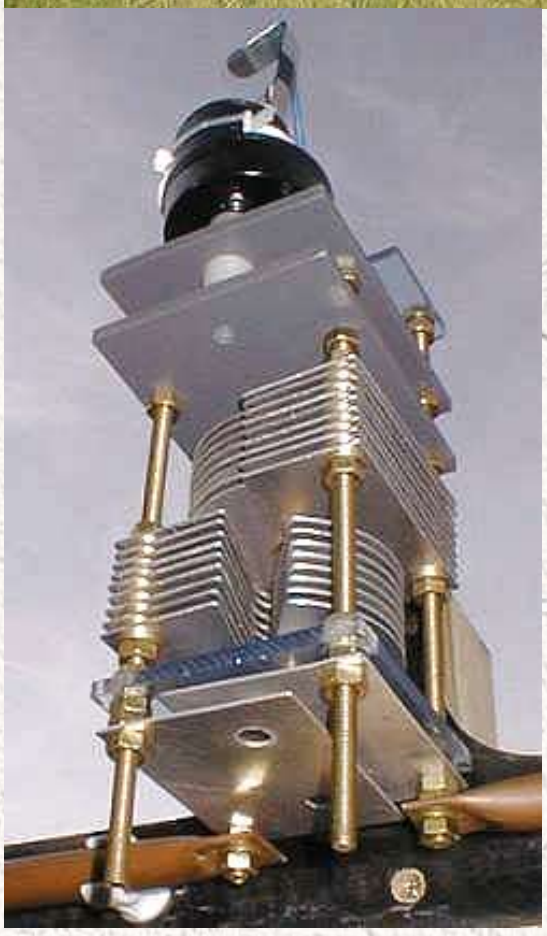
This is the first loop I build from a article in the QST from February 1996, it's 30 Inch-diameter, and it's designed by G2BZQ/WØ for 80 M.





Single Turn Magnetic loops





The first one turn loop that I built was made from 75 Ohm TV Coax and with a small explanation in the RSGB handbook for radio amateurs. I used the outer screen from the

coax and the results of the loop where good.The next loop I built is a octagon loop in 15mm copper tube with a circumference of
4.8 meter (16 feet).
The frequency range of this loop goes from 14 MHz to 7 MHz and works fine. The biggest problem is the tuning capacitor, if you transmit with a power
of 100 W you need a capacitor with a voltage rating of 5000 Volt.
A capacitor which can handle this voltage is hard to find over here and if you find one they are very expensive.
The first capacitor I built was a design from GW3JPT from a article in the RADIO COMMUNICATION from February 1994. It is a split stator capacitor with a capacitance of 140 pF and with a voltage rating of 6000 Volt.
The capacitor is remote tuned with the use of a small BBQ spit motor.

The second capacitor I built is my own design and it's a butterfly capacitor because the losses are lower than a split stator.
The capacitance is 5-65 pF and the voltage rating is 7200 volts. I used
it for the small loop with a dia. of 800 mm (2.66 feet) and the frequency range of this loop is from 28 MHz to 14 MHz. The Aluminum plates of 1 mm
for the capacitors are cut with a JIG SAW.

Most asked Questions:

I`d like to talk a little more on your setup. it seems like something whichI could get together if only some more data was available. do you have anynotes etc still laying about since its build ?

The theory for calculating the loop is very simple.The circumference of a magnetic loop is 1/4 wave of the designfrequency.

Example for 14 MHz.

300 / 14 MHz = 21.428 m is 1 wave

21.428 / 4 = 5.357 m is 1/4 wave circumference

5.357 / 3.14 = 1.706 m diameter.

The recommendations are that you can tune the loop from the design frequency to the frequency divided by 2 to keep the effiecency acceptable.

14 MHz / 2 = 7 MHz

I made the small loop (800mm / 31.5 ") from soft copper tube on a role that you can buy in a plumbershop and it's easy to make a nice circle if you draw on the ground a circle with a rope and a piece of chalk.

For mounting the loop to the hardboard I used plastic clamps
that they use for mounting copper tube on the wall.

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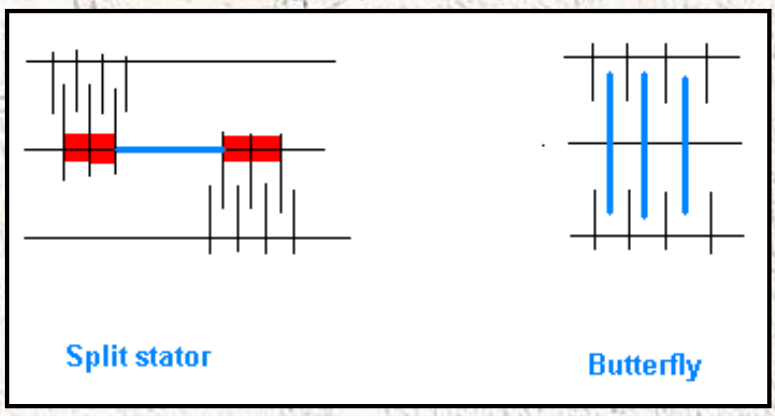
why is a butterfly capacitor better?

For high voltages and currents the use of Capacitors with wiper contacs is not recomended. That's why they use capacitors in serie's.The pro for serie's capacitors is that the voltage rating is doubled.The anti is that the value of capacitance is divided by 2.

For the split stator capacitor the 2 capacitors are connected in series by the shaft (bleu) and the red spots on the first drawing are losses.

For the butterfly capacitor the 2 capacitors are directly connected in series by the rotors and gives less losses.



Do you know of anyone that has built a similar loop that outperformed a garden variety dipole?

Compare antenna's is very difficult , sometimes I have for 60 % better signals in RX and TX on the loops then on the dipole.

In Theorie is the performance of a magnetic loop - 0.4 dB lower then a dipole or a vertical .

I have over here a homebrew trap dipole from 40-20-15-10m and the height aboveground is only 7 m(23 ft), for a good performance on 40 m the dipolemust have a height of 1/2 wave above ground (66ft). I don't have a radiation angle on 40 m and it's only good for contacts in Europe and not good for DX, now the 1.5 m loop tuned to 7 MHz with a effiecency of 38 % (38 w ERP) and a angle radiation of about 20 degrees performs better than the dipole because the vertical magnetic loop only 1 M above ground as a angle radiation and the dipole don't.

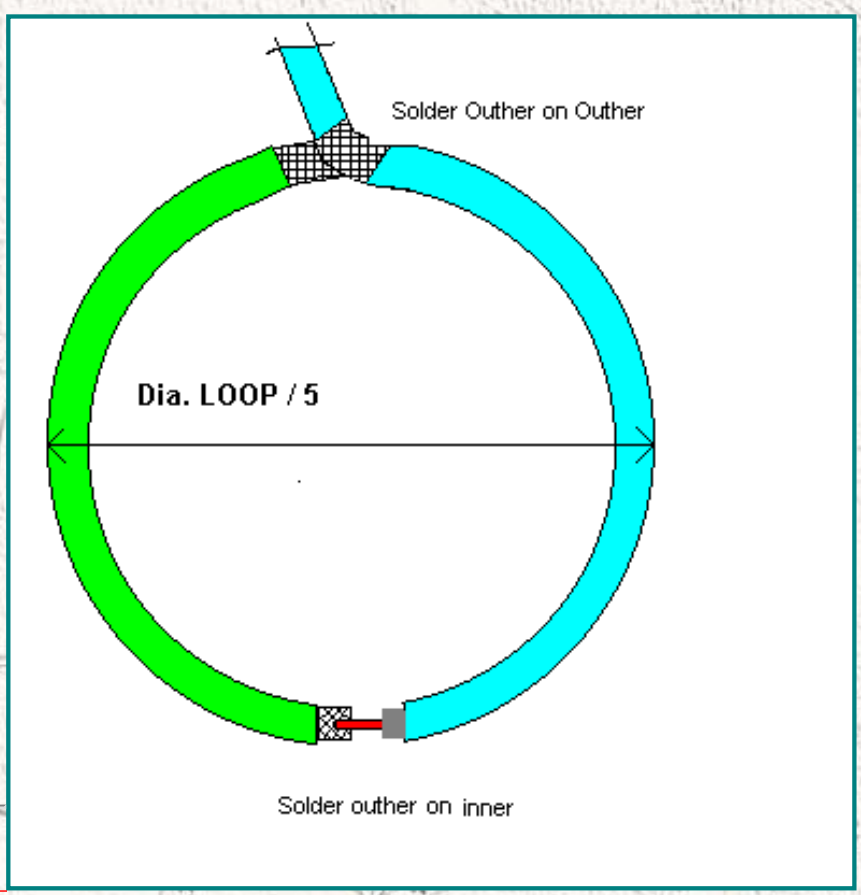
Another advantage is that the reception on a loop is mutch better, on 20m I have with the dipole S5 noise from the big city, if I switch to the loop I have S1 noise and hear stations who are buried in the noise when I use a dipole.

Coupling loop dimensions?

I find that the best way to feed the loop is with the shielded 1/5 Faraday loop made from coax RG213 or RG8, I tried the gamma match bud I had problems to keep the VSWR low on all Bands, the shielded loop gives on all bands VSWR 1.1 and reduce more noise pick-up then the gamma match.

I found out that if you use a 1/5 Faraday loop, that the loop is to big, making the loop smaller with 0.5 inch by the time in circumference and checking with a field strength meter you can see that the radiated power increase.

The place off the feeding loop is placed at the electrically neutral point on the loop and that is 180° from the capacitor and I have the best results with the feeding loop close to the ground and the capacitor far from the ground.



I was wondering if you worried about the resistance of the mechanical joints (copper pipe bolted to the capacitor) significantly reducing your radiation efficiency as I think the radiation of these antennas can get as low as .01 ohms

Soulder or weld the capacitor plates is always the best, but I'm afraid if you make the spacers and the plates in ALU that with welding everything is gona bend from the heat

and I know from practice (I work in a maintenance workshop) that welding ALU is coarse. Another possibility is using all brass or copper and solder, there are hams that using double PC board for the plates.
I made a QSO in phone with Florida, RPRT 5-5 and the other station used a vertical antenna, with the small loop (800mm and theoretical effiecency 41 % on 14 Mc) vertical in the garden and the states side is through the house. I was very happy with the results , so I think that a capacitor
maded with torqued compressed joints is good enough for using 100 W.

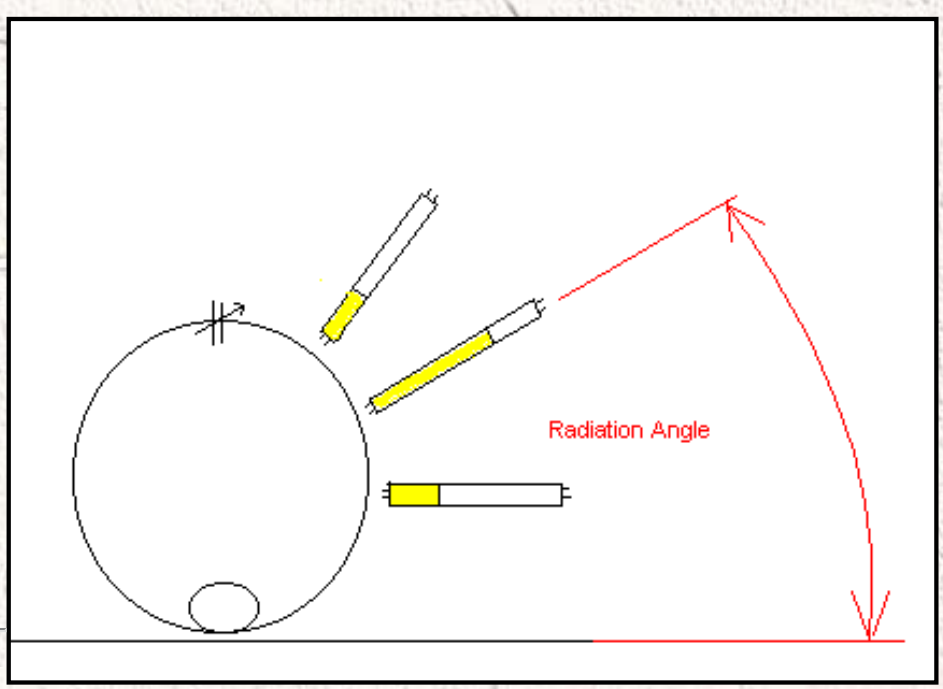
Have the dissimilar metal joints weather well?

To keep the oxidation low on the dissimilar metals I used a thin coat of vaseline after assemble the capacitor and with the tupper ware a like plastic box it is good protect against all wheather conditions.

How to find the radiation angle of the antenna?

Can it be found practically?

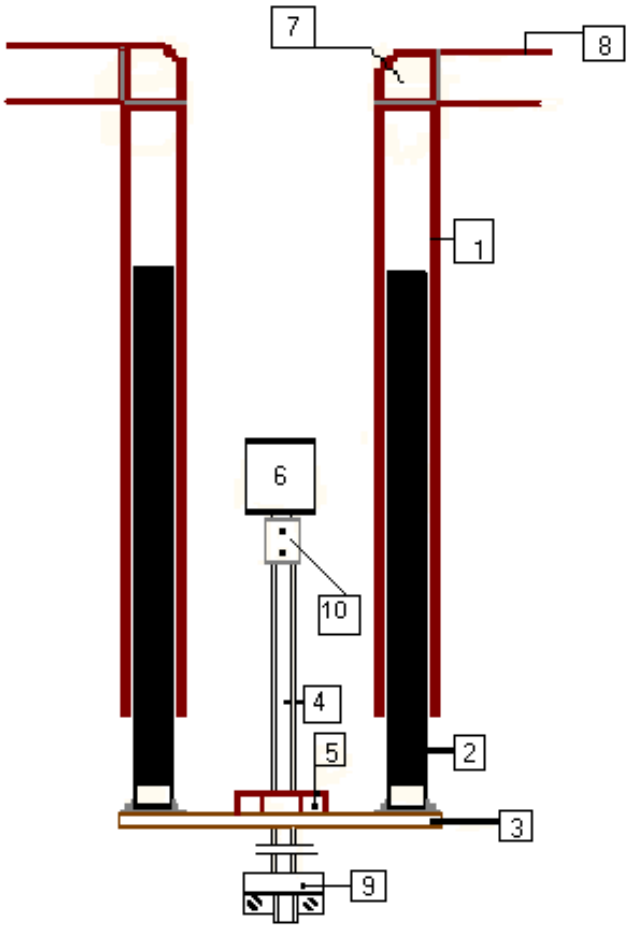
Finding the radiaton of a magnetic loop is very easy, with a TL-lichgt tube you can see it, with abt 10 w power on the the loop with the TL-tube in the plain of the loop at right angle to the circle you see the tube lightning, there where the the light is the farest on the tube thats the radiation angle.



When you refer to washers, nuts and rods you use the term "M6".Please forgive my ignorance, but to what does "M6" refer? Does this mean 6mm?

M6 is (M=metrical) and 6 is indeed 6 mm threaded rod and
you can compare the size with W1/4" (6.35mm) .

A very easy to build Piston Capacitor.



1) Copper tube

2) Coax RG8 or 213

3) Double PCB

4) Threaded Rod 1/4"

5) Brass nut

6) Motor with reduktion or stepper motor

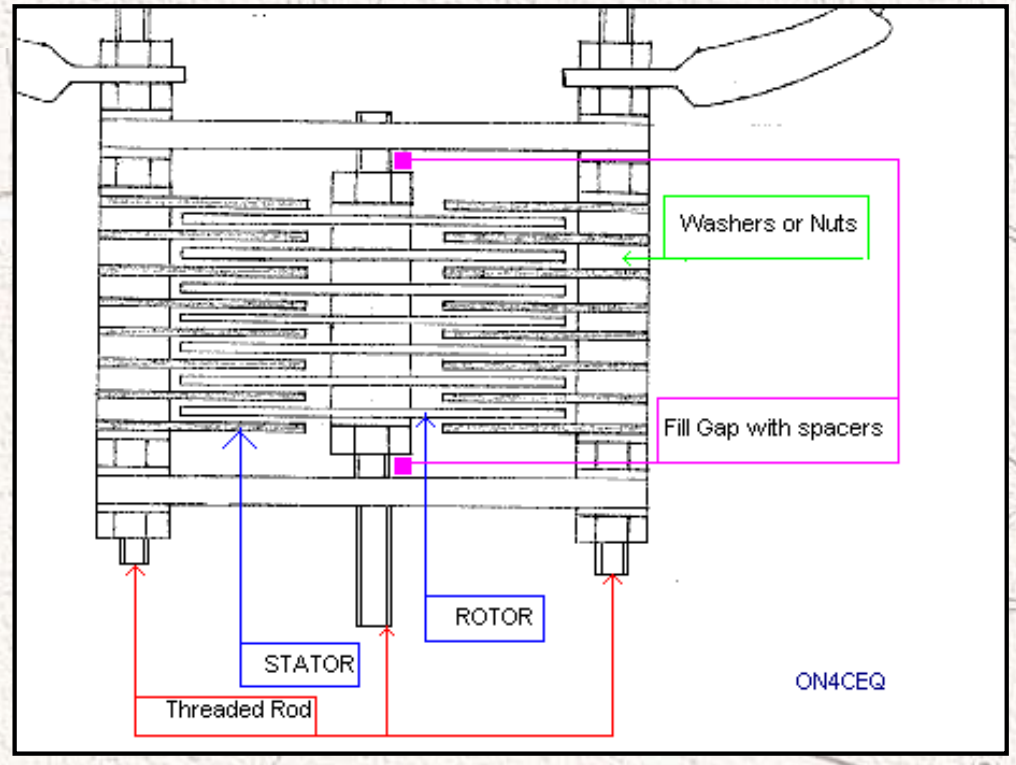
7) Copper Elbow 90°

8) Loop

9) Bushing from old var resitor

10) Couple shaft (PVC)

How to build your own Butterfly Capacitor.



The best material for the front and the back is CLEAR PVC 3 or 5 mm thick as alternative you can use GREY PVC or 2 sheets pcboard together with the copper removed .

The best material for the washers, nuts (M6) and threaded rod (M6) is brass or stainless steel,(NON MAGNETIC MATERIALS for the losses).

For the spacing of the vanes you can use 2 washers M6= (6Kv) or a nut M6 =(12 Kv) if you use aluminum plate 1 mm thick.

If you use a nut then the best thing to do is remove the thread by drilling withØ 6.2 mm.
The effective area for the vanes is 11.7 cm² and with the formula

for 2 washers = (0.0885 x 11.7 cm²)/ 0.1 cm = 10.35 pF for 1 air gap.

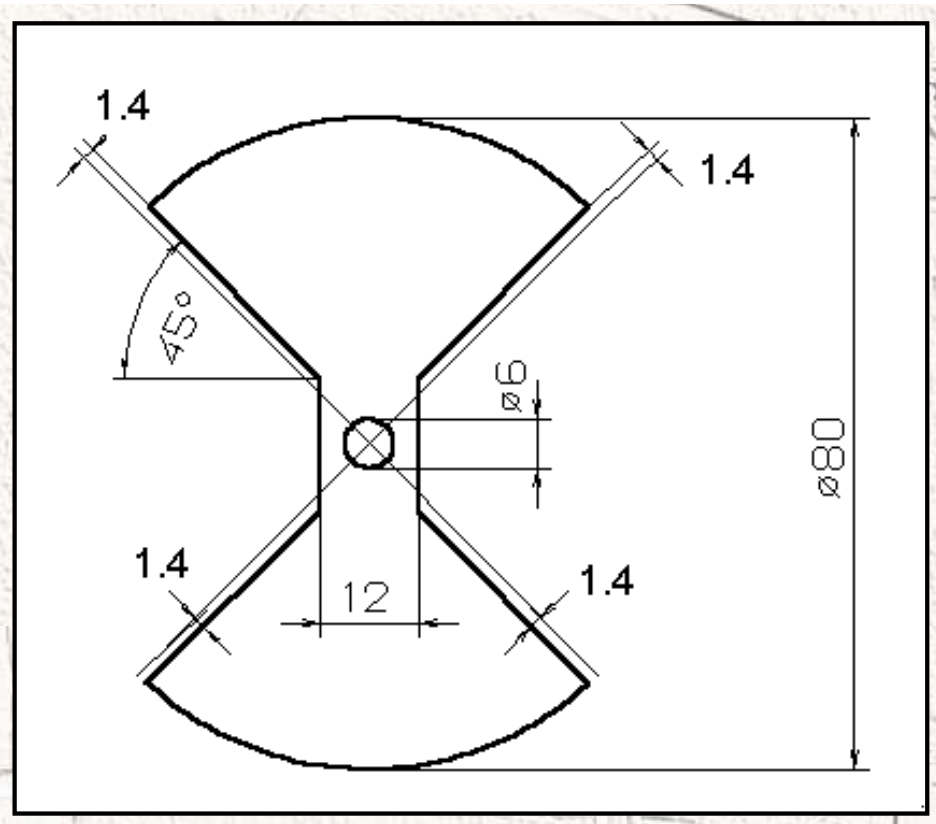
for 1 nut = (0.0885 x 11.7 cm²)/0.2 cm = 5.17 pF for 1 air gap

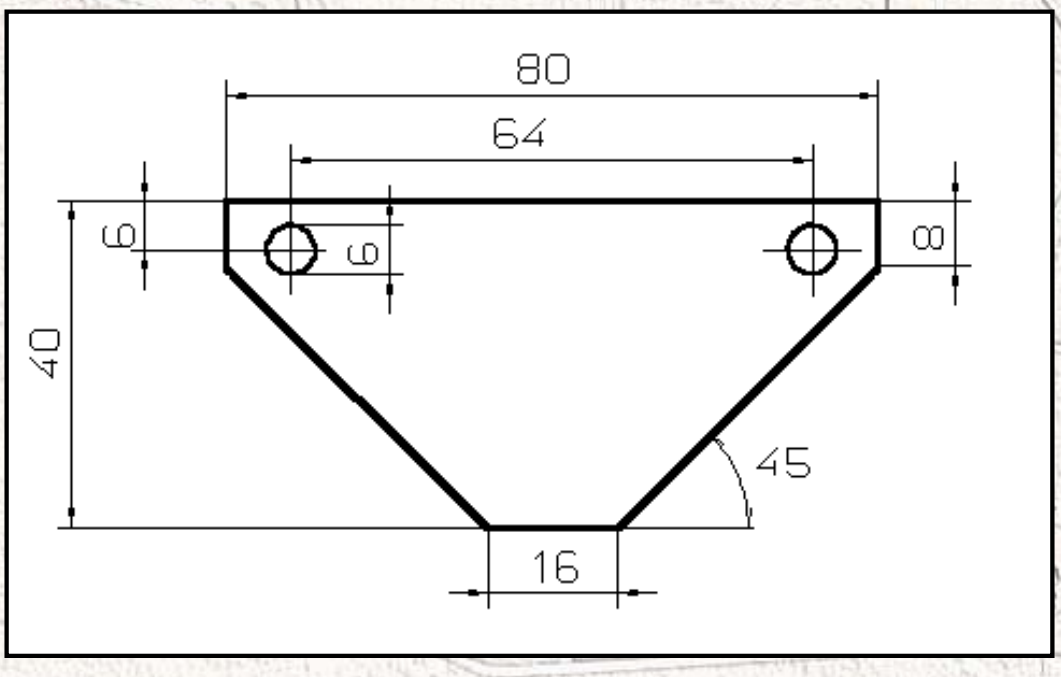
Example:

If you you make a capacitor with 2 washers as spacing and you make 5 rotor vanes and 6 stator vanes then you have 10 air gaps.

10.35 pF x 10 = 103 pF + 10 pF stray capacitance = 113 pF / 2 = 56 pF

The final result is a capacitor with a value from 5 - 56 pF.


1.4
1.4
45°
ø6
ø80
1.4
12
1.4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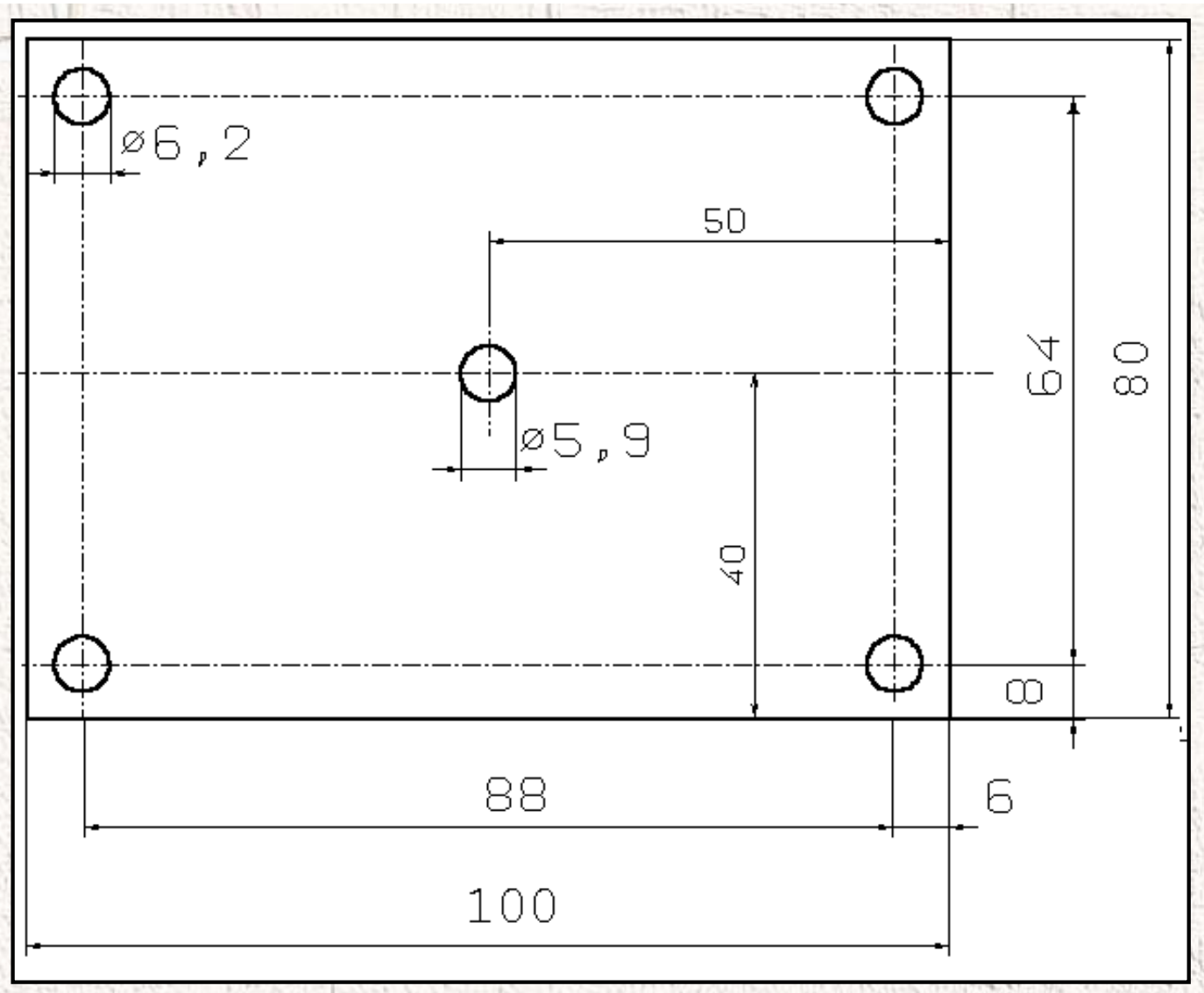
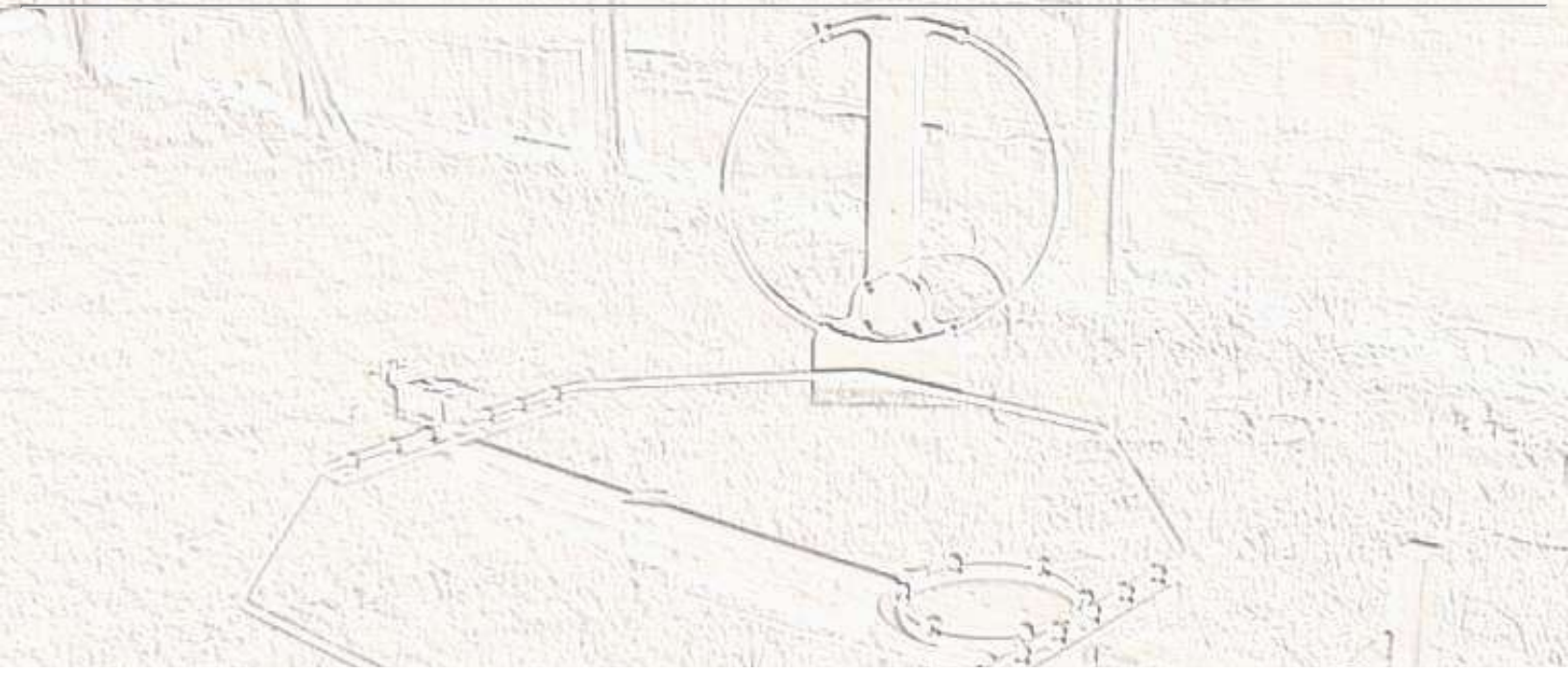


Last Update 03 December 1999. ON4CEQ Van Herck, Tony QTH: Anwerp(JO21FF) BELGIUM.



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THE WOODEN ALTAZIMUTH "HOOP LOOP"

A Saga by Linus

BACKGROUND

It all started with finding a nice, wooden embroidery hoop at a local flea market, about 22 1/2" in diameter. Close to two feet across. It is about an inch and a half wide. I got to thinking about making it into a loop antenna, and since it was only three dollars, I went ahead and bought it, figuring the idea would hit me at some point. Well... After guessing, thinking, over the last few weeks, I just went into my shop and started building what my mind had started to see. What has resulted is a very stable, well-balanced and powerful loop antenna, light-weight and able to achieve deep nulls, and is so far really impressing me! It's in a fairly preliminary, 'prototype' stage, and improvements and additions are forthcoming, but for now read on...

MAKING THE "HOOP LOOP"

I knew I wanted it mounted to a stable base/lazy susan for rotation, and that was easy. The big outer hoop mounts to a 9" square, 1" thick piece of plywood. Easy. Then, I wanted to make the inside hoop swivel to get an altazimuth feature like the big Kiwa model, which would surely assist in deep nulling of unwanted signals, noise and so on. Very carefully, I measured where my two points would be to hinge it with the best balance (more on balance later) and drilled the holes for the nylon screws I had in the junk drawer. It worked fine, and it swivels beautifully.

After drilling the holes and inserting the screws to test the ease of angling, I then removed the screws and began the tedious work of affixing the wire to the outside surface of the inner hoop. I realized I had to wind the loop in two sections, so that the screws for the altazimuth hinges could be accomodated. Measuring and testing, I found that I could wind 6 turns of #22 insulated wire on one side of the inner hoop, wound with no spacing between turns, THEN leaving about 1/8" space for the screw holes, and then another 6 turns to complete the 12 turn loop.

I thought about simply pulling the 7th turn away from the first 'set' of 6 turns, at the bottom of the hoop, and then continuing the rest of the winding, leaving two equally

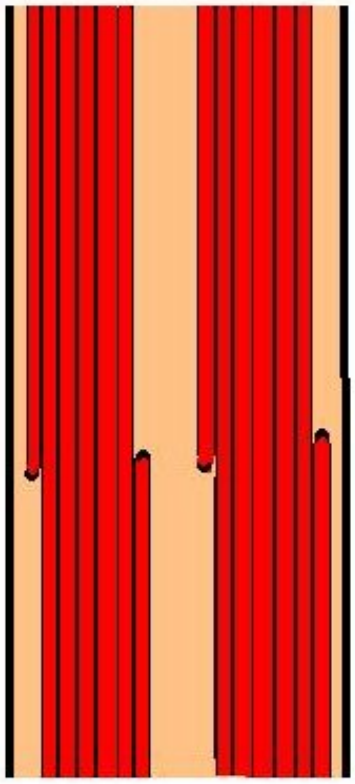
sized 'sets' of windings, but continuous, leaving a space for the screws on the sides of the hoop... but this seemed kind of too quick and dirty for my mood. It will work though, but my method is kind of hard to describe.

I drilled four holes in the bottom of the inner hoop, and placed my starting end of wire into the farthest hole. Then, when I got to six turns (so long as you keep good tension on the wire as you wind it, it won't fall off the hoop. You could try to use tape or something to hold it, but it was pretty easy for me without it. Just keep it taut!), I cut the wire and inserted that end into the next hole. Pulling it through the hoop, I anchored that end to a small eyehook for temporary tightness.

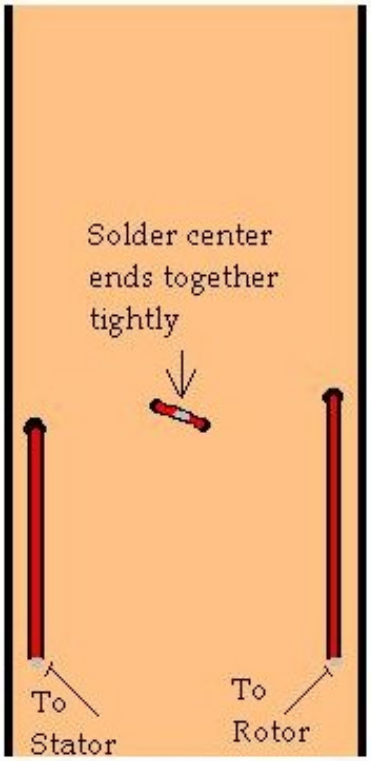
Then I started another end of wire, following the same direction as the first set of 6 windings, and anchored the end to keep it tight, and finished the last 6 turns. Then, put the end of the winding into the last of the four holes I had drilled, and anchored that too. When that was done, I had two sets of 6 turns each, each set wound without spacing, but the two sets spaced from each other about an 1/8" apart to accomodate the screws for swiveling.

It's a lot easier to see it and do it than to describe it. See the images. (They're homemade MSPaint images, sorry if they're not clear enough).

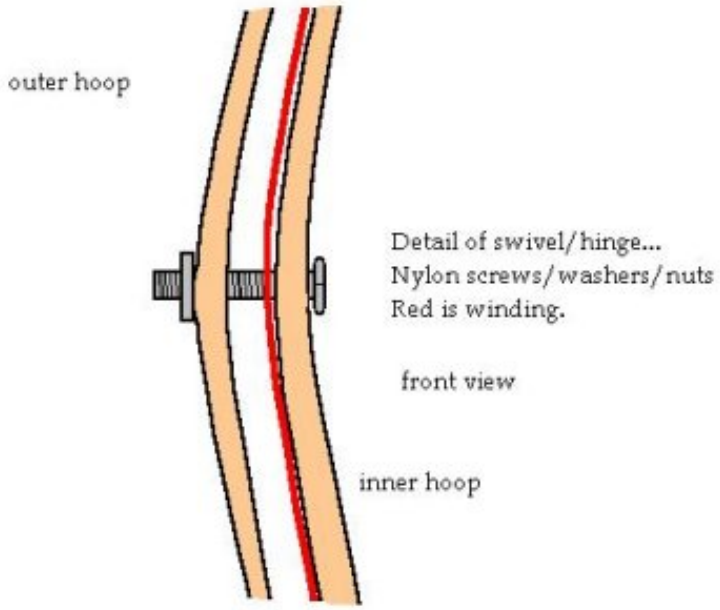
Anyway, the two anchored wires from the center of the hoop (where the space is made for the screws) are soldered to each other, keeping them tight. Now you've got a continuous loop. The other ends of the loop go to a 365pf variable capacitor which rests on the inner hoop, inside the hoop. Again, see image to get the concept. Now, the loop will rotate side to side AND top to bottom.



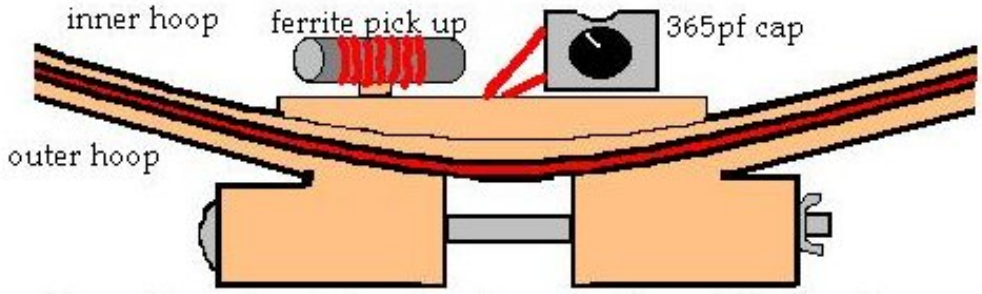
Detail of Loop Winding
Bottom of inner hoop, underside view



Detail of Loop Winding, Hook-up
Bottom of inner hoop, Top view



The next thing was to get it to lead out to my receiver (R75) which does not have a ferrite antenna built in. I spent some time on this question, then as a quick experiment I took a small ferrite rod, 3" I think, and wrapped it with about 20 turns of #18 insulated wire. The two ends of this winding I soldered to a length of small coax cable (RG174), one end to the center conductor of the coax, the other end to the shield/braid. The other end of the coax hooks into the + (center conductor) and -- (shield) terminals of the HiZ antenna input on the R75. I left enough cable to allow free movement and rotation of the loop, no less than a foot of cable. Too much cable might de-tune or upset the balance of the loop, but experts may be able to answer this question.



Base of hoop, front view, showing capacitor and ferrite pick-up coil
(ferrite is slightly angled for clarity, it should be perpendicular!)...

At any rate, the ferrite rod bundle is placed on the inner hoop next to the 365pf cap, facing perpendicular to the plane of the loop (just as you would place a portable radio in relation to a loop)... the ferrite rod is attached with some double-sided foam tape, but a more permanent mount can be created. This is, after all, a prototype! :-)

In order to get good balance, I had to mess with how wide I had the outer hoop opened up (recall, this is an embroidery hoop, you know the type, you have to open it up to place the fabric into it, and tighten it again to secure the work) and where the holes were drilled for the swiveling screws. I also had to add some counter weight to the top of the inner hoop to balance the weight of the 365 cap and ferrite bundle on the bottom of the inner hoop. I used some very sticky double sided foam tape, and attached a spent AA battery. Tried the swiveling, but still bottom-heavy. Then I added another battery and so on until I had five AA batteries up there, and now when I angle the inner hoop, it stays put it any position! Lucky me.

The obvious thing to do now is to find a decent weight that looks nicer and is a little more accurately weighted for really good balance for angling and staying put. Also, I want to add a varactor-tuned

system, to allow me to remove the small 365 air-core variable AND the ferrite pick-up loop, leaving one wire (probably RG174) coming from the inner hoop, to a small control box (tuning knob, circuit and battery!) at my fingertips. This would decrease the bottom weight of the inner hoop, and demand less counterweight accordingly. The coax to the receiver would come from the control box, not the loop, so no pick-up loop or ferrite is required, and therefore less stress and drag on the loop.

Also, it seems much better in null balance than any other loop I've used. Perhaps it's the two sets of windings rather than a single, spaced set of turns. All I know is, at night time, I can find the same dB of nulling at 180 degrees of either rotation. It's not skewed at all!
No, it's no Kiwa, has no Q-multiplication or amplifier, or heavy base for stability like the Kiwa, but the electronics can be added to the control box if I wanted to do so. It's light enough to be placed on a simple wooden base, and rested atop a plastic lazy susan, without stressing anything at all. It's very smooth in rotation and angling. I'll probably give the whole thing a good paint job when I'm done, to look a bit nicer (what are we if not civilized?) but even as it is, it's REALLY working well.

Nulls are deeper, sharper, than any other homebrew loop I have used, and the size of the loop FAR outperforms the S-A-T and the Terk loops, and in terms of nulling AND strong-signal handling, works better than the 4' box loop I used to think was my best loop (it was until now!)...

RESULTS ARE QUITE IMPRESSIVE

Between 10:30 pm and 1 am, I was able to null two very strong locals, to complete silence, enabling me to copy two stations I had not been able to hear before. Ever.
Also, one of my age-old DX targets has been KNX1070, Los Angeles. I used to listen to them all the time when I lived there, but have only been able to hear them in SW Missouri once or twice over the last decade, even with an MFJ phasing unit and two very long wires. This loop was able to get rid of offending sports and gospel stations (well, 'offending' isn't really the word, I like sports and gospel music... I should say 'unwanted' stations!) on the same frequency, and while there was still some noise, I logged KNX1070 for the first time in years! All attempts at achieving the same level of clarity with the phased antennas could not compare to the loop. In fact, I could not hear the signal on either of the longwire antennas, and phasing only resulted in very weak copy with a lot of hash and two hets whining away in the background. In average conditions, this loop heard something that no other antenna *I* use could hear. Very impressive for me!

Daytime use has proven to me how deep and lasting the nulls this loop can acheive really are. Across the band, I nulled into oblivion all major stations in my area (560, 940, 990, 1060, 1220, 1260, 1510 and 1610, three of which transmit at full power less than ten miles from my location). It also picks up a number of daytime broadcasters within a five hundred mile range in a clean, noiseless manner which is superior to my longwires, phased or not, during the day. The signals are there on the phased array, and louder than the loop, but far noisier and when properly nulled are still much noisier than the loop gives me.
In short, the Altazimuth Hoop-Loop project has been WELL worth the effort, and only cost $3 since I had everything else in the junk boxes. If I had to get it all new, it might be a $20 project (the wire, about 70 feet of #22, the tuning cap is about $10 from the Xtal Set Society, small and smooth-tuning, and the hoop, well, if you can find one, who knows? Cheap-cheap!)...

WHAT'S IN A NAME?

I thought about calling this loop the KIWOOD Loop, but thought Craig S. at Kiwa wouldn't like that much. His loop is state-of-the-art, of course. The Termite's Feast? Washington's Teeth Special? The Lumber-Loop?

Whatever the name, this is a very worthy passive, altazimuth round loop, which covers the whole MW band and affords the user with excellent nulling and directionality. I like surprising myself! You may be surprised too!

Stay sincere!
Linus, The GrtPmpkin

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Long Distance Medium Wave Listening

by Steve Whitt (UK) & Paul Ormandy (New Zealand)
Additional material by Andy Sennitt (Radio Netherlands)

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1. Introduction: What is Medium Wave DXing?
2. Who Goes There?: What sorts of signals can you hear on MW?
3. Getting Started: You don't have to be rich - or even awake!
4. The Identification Question: Don't make assumptions
5. DXpeditions: Giving up home comforts in pursuit of rare signals
6. Equipment: The tools of the trade
7. Antennas: To the MW DXer, a beverage isn't something you drink!
8. Propagation: How Medium Wave signals reach your ears
9. Interference: The sounds you don't want to hear
10. Some Audio Samples: Eavesdrop on Paul Ormandy's receiver
11. Reception Reports: How to verify your reception
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13. The Wetter The Better? How the weather affects MW signals.
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Dave's Radio Loops

Next

Dave's first homemade loop antenna.

Introduction

Welcome of my homemade loop antenna pages. All the loops described here were designed and built by myself. The features are not real different from loop to loop. These loops are made to enhance radio reception in the broadcast band range. Some of the loops are just one coil, some have tuning capacitors and some have an extra coupling coil. Read on and discover the fantasy of loop antennas. Or fetish in my case.

The loop shown above is my first loop and it has only one winding. This ended up connected to my 4 tube radio. I used pine wood cut to 5/8 inches by 3/4 inches. There are three pieces 12 inches long and another 16 inches long. The squares in the center are about 3x3 inches and are 3/16 inches thick.

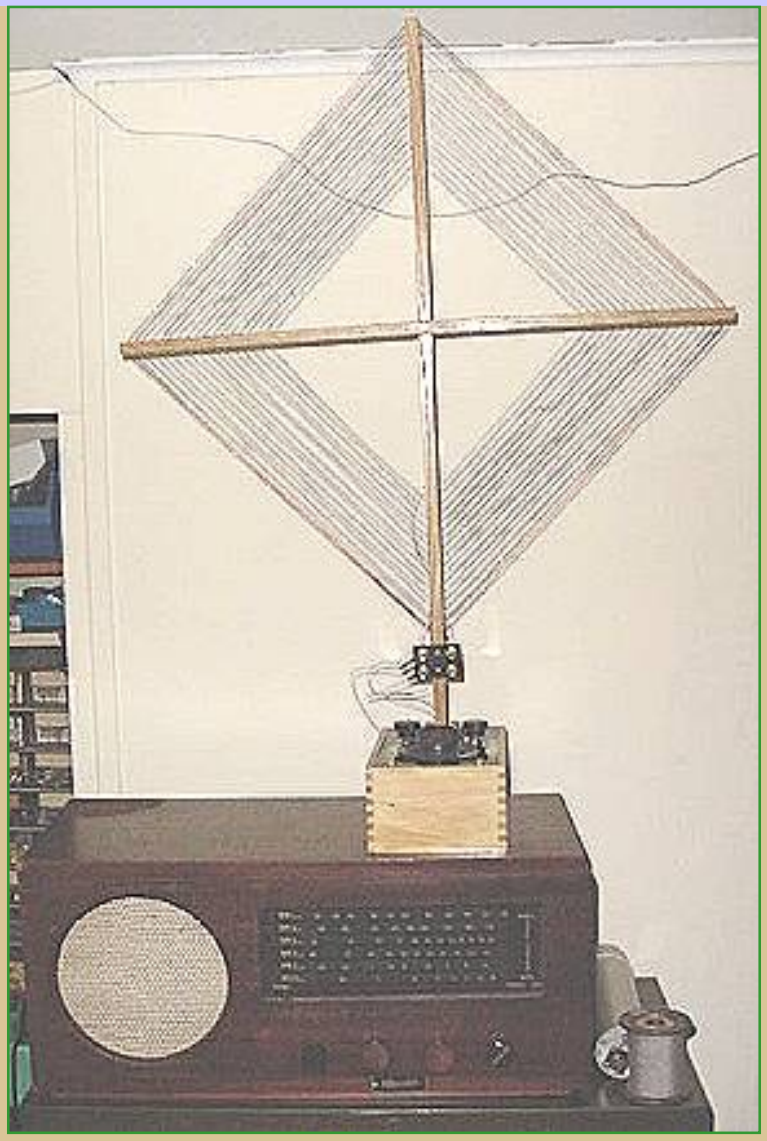
The wire is 23 gauge enameled magnet wire, but you can use what you have and what looks cool. There are 15 full turns of wire. I drilled 15 small holes starting 3/8 inch in and at 3/8 inch intervals. The bottom leg (the 16 inch long) has an extra hole at the bottom so the winding will start and end on that section of the loop. You will have to spool out 70 feet of wire and thread it all the way through. Be careful that the wire doesn't kink and you should have a big enough space and two people to do this job. I did it by myself, but it took a long time to wind this loop.

After the loop is done, take a piece of wood, or some left over garolite like I did and drill two countersink holes to attach to the frame and two more holes for the connection hardware.

I made the base with two pieces of oak wood. One is about 7 inches square and the other is 4 inches square. Use what you have. Sand, stain and shellac the wood, then attach them together with 4 flathead wood screws. Drill a 1/4 inch hole in both the base and the loop and put in a dowel rod to attach both together. If the dowel doesn't easily go in, sand it until you get a better fit.

Check out my crystal loop antenna/receiver.

Loop For My Old Sparton Radio



Here it is friends. I made a loop specifically for one radio. This my loop #6. I was using my "test" loop (which is shown below) to see how my Sparton radio would perform. I was impressed and since I use that my Sparton a lot, it deserved it's own loop.

I decided that this antenna had to be *lightened up* a little. The two garolite squares had to go. I cut a notch in both pieces of wood so that they would interlock. The pieces are glued and fastened with a single flat head wood screw.

The wire is wound with some of my litz wire. Litz isn't really necessary but the wire is more flexible than the magnet wire. This makes a nice looking wiring job when finished. You will need 70 feet of wire for the tuning coil and about 14 feet for the outer coil. I thread the wire for my loops outside where there is room to pull the wire. The drilling and other details are contained in the drawing shown below.

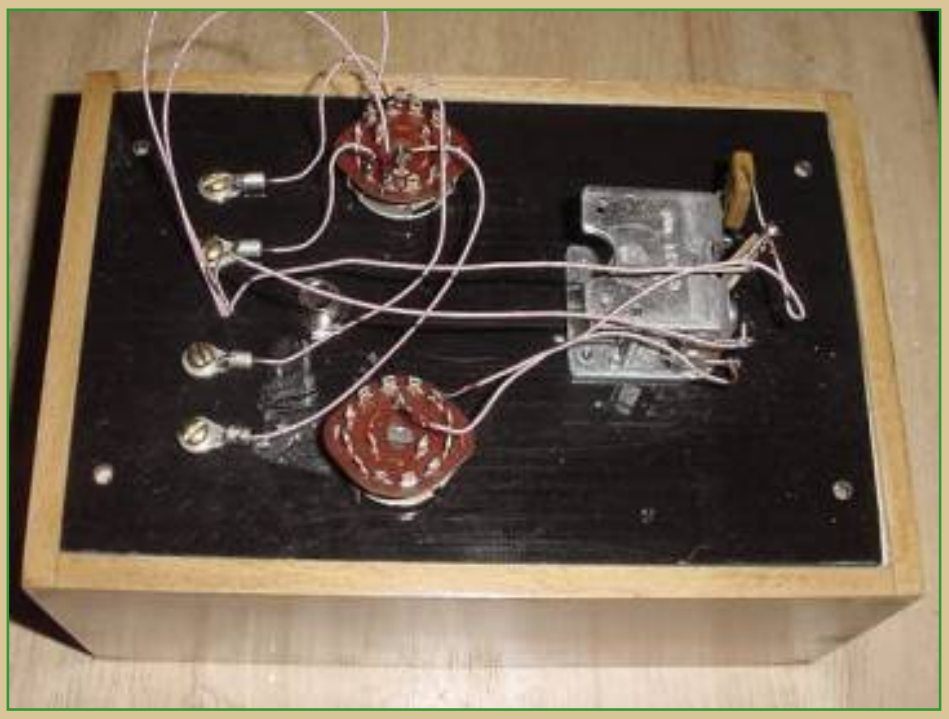
I used litz wire between the loop terminals and the base box. Earlier I had used 18 gauge PVC covered wire. This was too stiff and the loop would not stay in the position it was turned to. Just one of those little learning things.

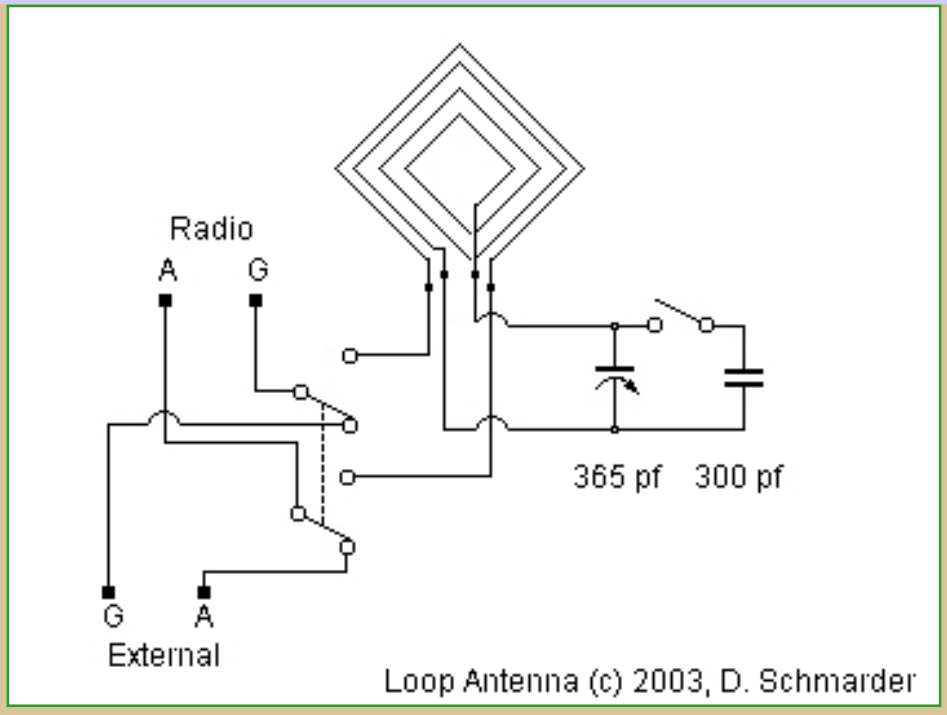
A base box isn't necessary. All the parts could be mounted on the loop itself, or a small board could hold the loop with a small panel for the other parts. But I like those basswood boxes that I have.

The Sparton radio is a multi band set and the shortwave bands require a different antenna. I added a switch and some

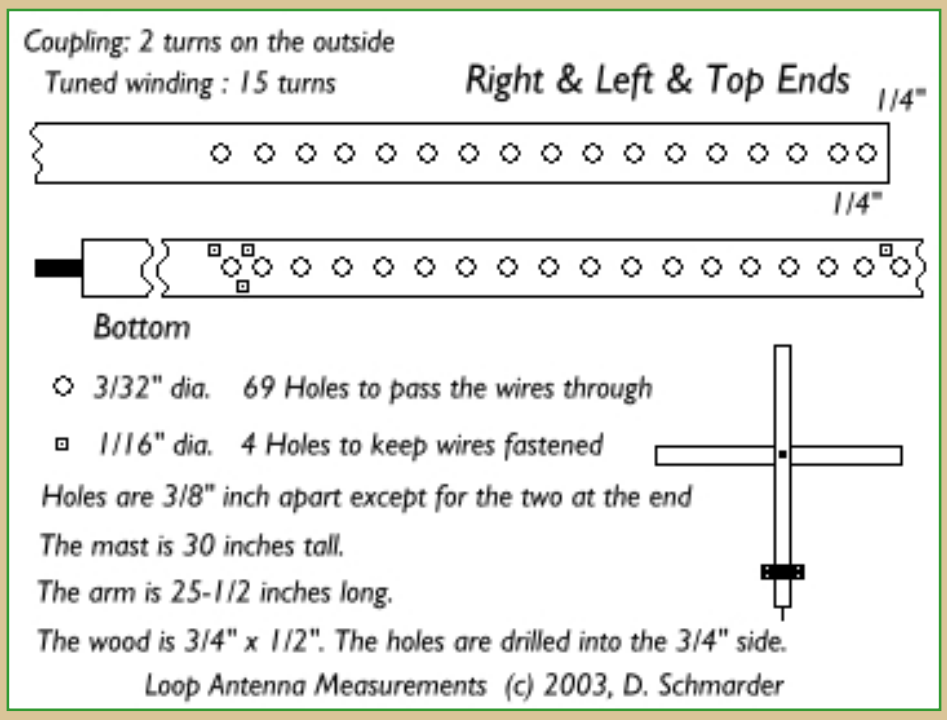
terminals to accommodate this need. The radio antenna is switched between the loop coupling coil, or an external antenna and ground. The other switch is a high low band switch and adds a 300 pf capacitor across the 365 pf variable capacitor. A larger value of variable capacitor would tune the whole band in one chunk.

This loop is not real expensive to build, but they require a lot of building time. Use your imagination and you will be as proud of your loop as I am of mine.





Loop schematic


Coupling: 2 turns on the outside
Tuned winding : 15 turns
Right & Left & Top Ends
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1/4"
Bottom
3/32" dia. 69 Holes to pass the wires through
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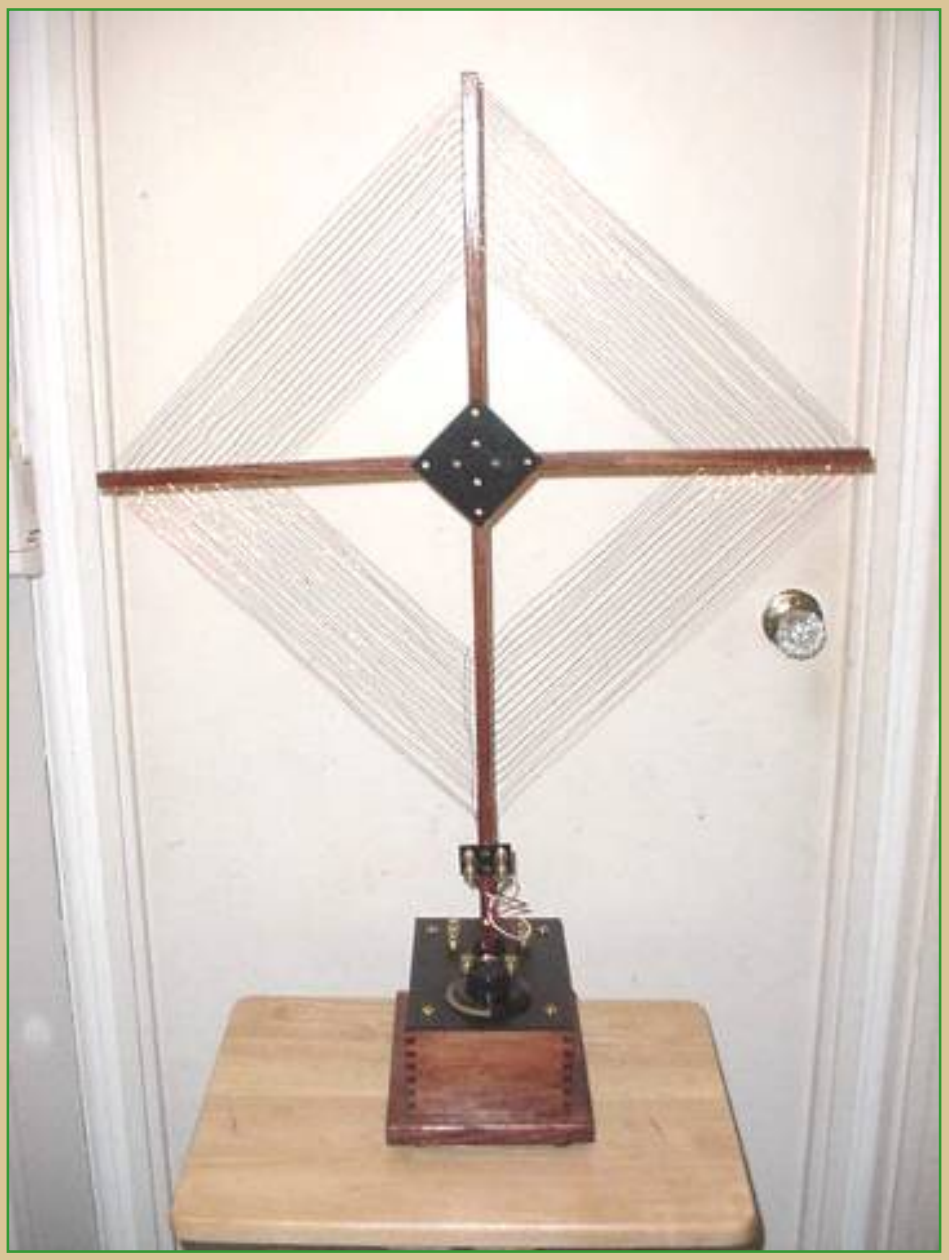
Holes are 3/8" inch apart except for the two at the end
The mast is 30 inches tall.
The arm is 25-1/2 inches long.
The wood is 3/4" x 1/2". The holes are drilled into the 3/4" side.
Loop Antenna Measurements (c) 2003, D. Schmarder

Hole drilling detail for my homemade loops.

R & D Loop



This is my 4th loop. Sorry for leaving #2 and #3 off the site, but those were so much like my first that I decided I would wait for something worthwhile to offer. This is worthwhile. I wanted a loop with lots of bells and whistles to do my radio experiments. Look at what this loop has to offer.

This loop has two windings. The larger winding (15 turns) is connected to a variable capacitor for a large tuned circuit. Since a single 365 pf capacitor will not tune the entire broadcast band, more capacitance has to be added. In the case of my dad's loop (shown below), he switched a 300 pf fixed capacitor across the 365 to allow tuning down to 540 khz. I am using a ganged capacitor and a switch. Included is a third position of having no capacitor across the coil. I did this as some of my radios tune the antenna loop by a ganged capacitor inside the radio.

The other winding (2 turns) is to connect to the antenna input of the old BC radio. I picked two turns as that emulates the single turn that my dad had on his larger loop.

This loop has 3 wood pieces. The arms are 12-1/2 inches long, and the main pole (vertical part) is 30 inches tall. This is

a little larger than my earlier loops so that I would have room for that extra winding. After the holes are drilled, I stained the oak with Minwax Red Mahogany stain. After the gloss deft dried, assembled the loop using two 3x3 inch square pieces of garolite. Thin wood, plastic or anything you have around will work. Before you mount everything, fit it together and take a look to see if it looks right.

Another change from my first loop is how the ends of the wires are handled. So that the wire wouldn't work loose, I drilled an extra hole close to each end hole on my loop. This makes 2 extra holes I had to drill. What the heck, holes are cheap so I splurged. The extra holes are about 3/16 inch from the end holes. The wire can be then looped around a couple of times. This holds the ends secure and looks neat too.

On the top of the mast pole and each side arm, I drilled 17 holes. I used a 3/32 inch drill but it isn't too important the size of the hole. Each hole is 3/8 inch from each other and I started 3/8 inch from each end.

Then measuring down from the top of the pole 25 inches, I drilled a series of 21 holes going back up the pole, 15 holes, one for each turn, one for the end winding. Then two extra holes close spaced for ending the tuned winding. . When the wire is wound on this loop, it will look like a square.

Three more holes are drilled for the untuned winding. I looped the both wires once through the middle hole as with this winding, having the ends so close wouldn't matter. I think that comes out to 21. Lets see.... 15+1+2 +3 = 21. Good thing I stayed awake in the first grade!

You with me so far? Good. After I wound the wire, I made a little 4 terminal connection block from another piece of garolite. I also drilled a 1/4 inch hole in the bottom of the pole and inserted a dowel rod in the hole. This is the weak point of the loop. If the loop falls over the dowel will break and need replacing.

Next I built the box that serves as a base for the loop and holds the capacitor. I used a cut down basswood box, a piece of 3/4 inch thick oak as a base and some 1/8 inch garolite as a panel. I took a 1x1x3 inch piece of wood and screwed it to the garolite. This is so the 1/4 inch dowel will be stable in the loop base.

Using that big thick 14 gauge wire, I make the connections to the capacitor and link switch. In my case, I used a 3 gang capacitor. That made it easy to use a single link switch to do what I wanted it to. You could make two spst link switches, one to add a fixed or second gang and the other to disconnect the capacitor from the circuit. I built mine the way I wanted, and you can build yours any way that is handy for you.

So I can use this loop several ways:

Connect a radio to the untuned 2 turn loop and tune the main coil with the capacitor.

Hook an antenna and ground to the two turns and a diode and earphone on the tuned side for a cool crystal set. Or if I was really close to the station, forget the antenna and ground.

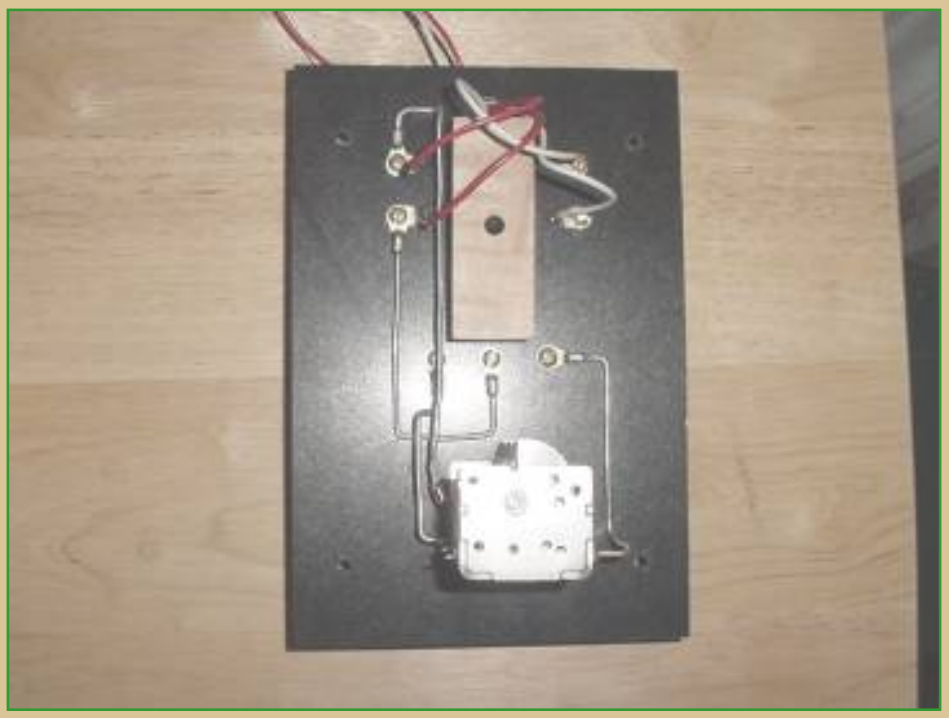
Use the untuned winding as a tickler coil in a regenerative set.

Use only the large loop without the tuning to connect to a radio. This loop could be used to replace a built-in loop on a radio.

Connect the coupling loop between a wire antenna and a crystal set for a wave trap. Make sure the loop is turned to null the station you want to trap.

Maybe I could use this loop to strain my spaghetti. Anyway, below are some pictures of how I constructed the loop. If something is unclear or you have a better idea on something, please e-mail me. These loops are very cheap to build but take a long time to make. But they sure look cool sitting on top of your old radio. Best of luck with yours!
Dave

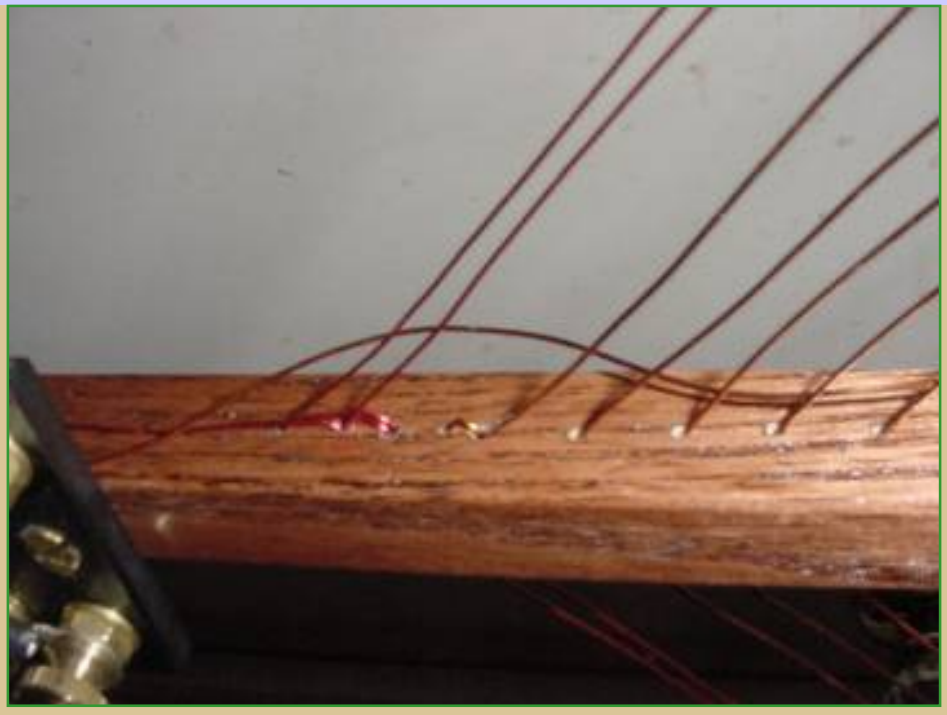
Top of panel with loop plugged in.



Underneath view with old time wiring.

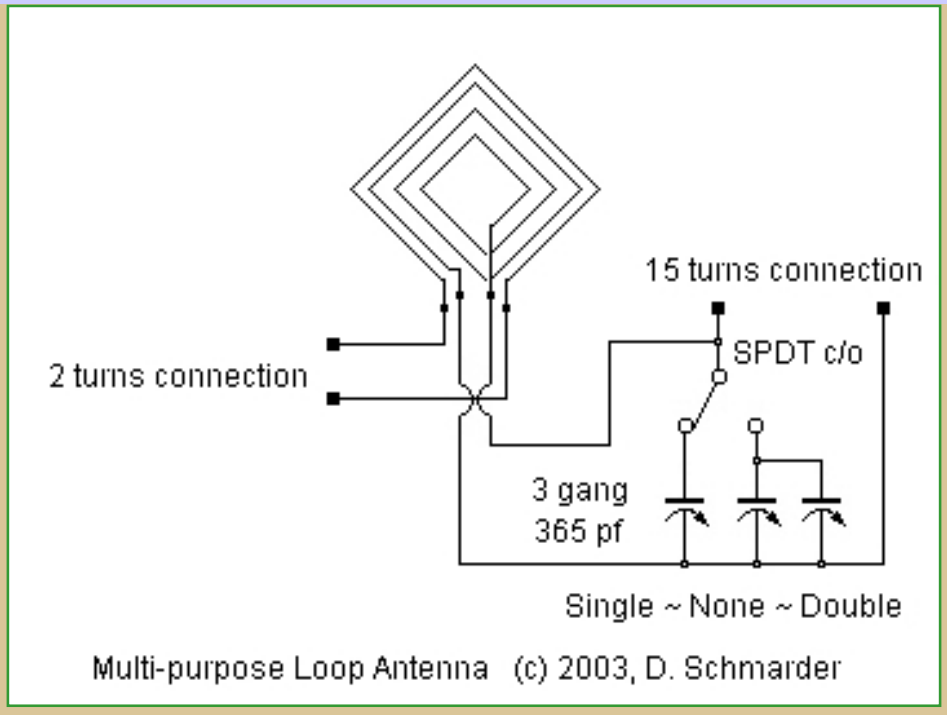
The bottom base box.

Panel view with loop removed.

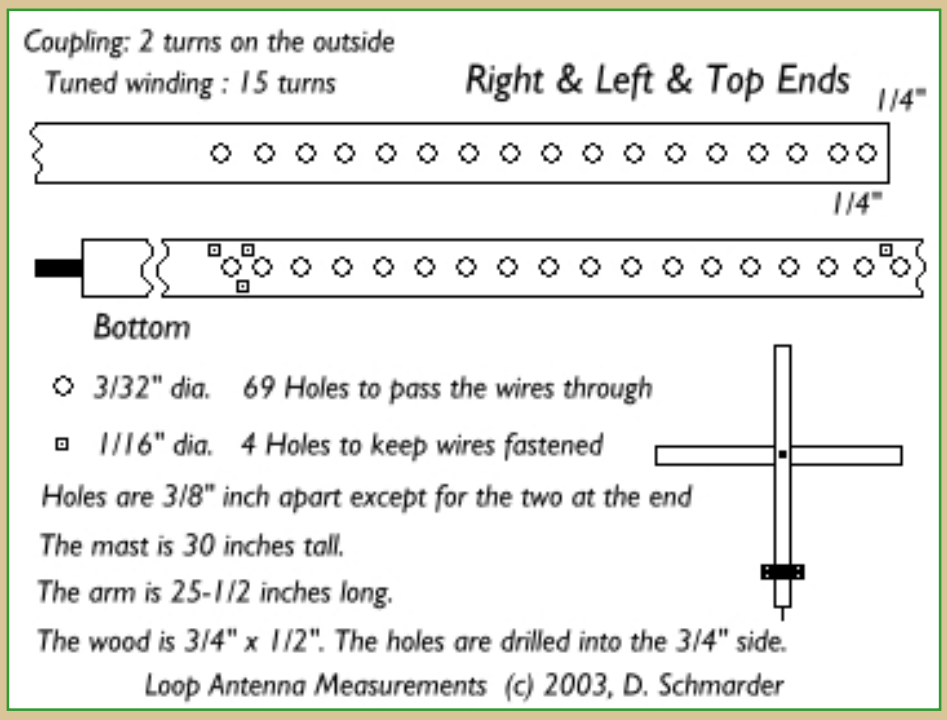


Bottom of pole showing end wire looping.

Left side arm showing 17 holes with wires.



Schematic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Hole drilling detail for my homemade loops.

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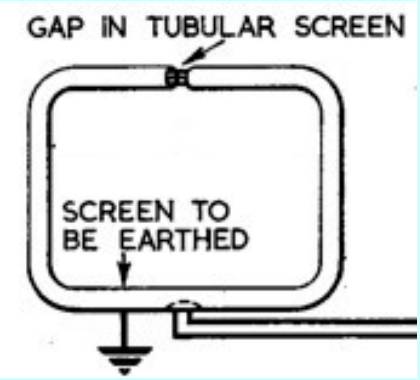
RECEIVING LOOP AERIALS FOR 1.8 MHz

by Lloyd Butler VK5BR

Originally Published in Amateur Radio September 1990)



Basic Shielded Loop

Localised noise in the receiver can be reduced by using a small loop aerial. Shielded coax loops, unshielded loops and ferrite rod loops for 1.8 Mhz have been compared here. Best peformance has been achieved with with 6 & 1/2 turns unshielded on a 0.8 metre frame and connected via a balanced interface amplifier.

Introduction

The theory of how a small loop aerial can reduce locally generated noise is described in a previous article.

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In the March 1982 issue of 'Amateur Radio', Clarrie Castle VK5KL described a receiving loop aerial for 1.8 MHz. The octagonal shaped loop, some three metres in length and breadth, was formed by a single turn of coaxial cable, the outer braid of which provided the electrostatic shield. From all accounts, the aerial was very successful in improving the received signal-tonoise ratio in the presence of localised noise interference.

It seemed to me that perhaps the same performance could be achieved with a loop of smaller dimensions but with more than one coaxial turn. This would allow operation in a more confined space and even inside the radio shack. With this in mind, the performance at 1.8 MHz of an 0.8m square multi-turn coax loop aerial has been investigated. Also examined is an unshielded version of the same sized loop aerial and a ferrite core loop aerial made for the 1.8MHz band. The performance of each is individually discussed and then compared.

Loop Sensitivity

For a tuned loop oriented to give maximum signal (that is, its plane in line with direction of signal source) the loop sensitivity (Es/e) can be defined as follows:

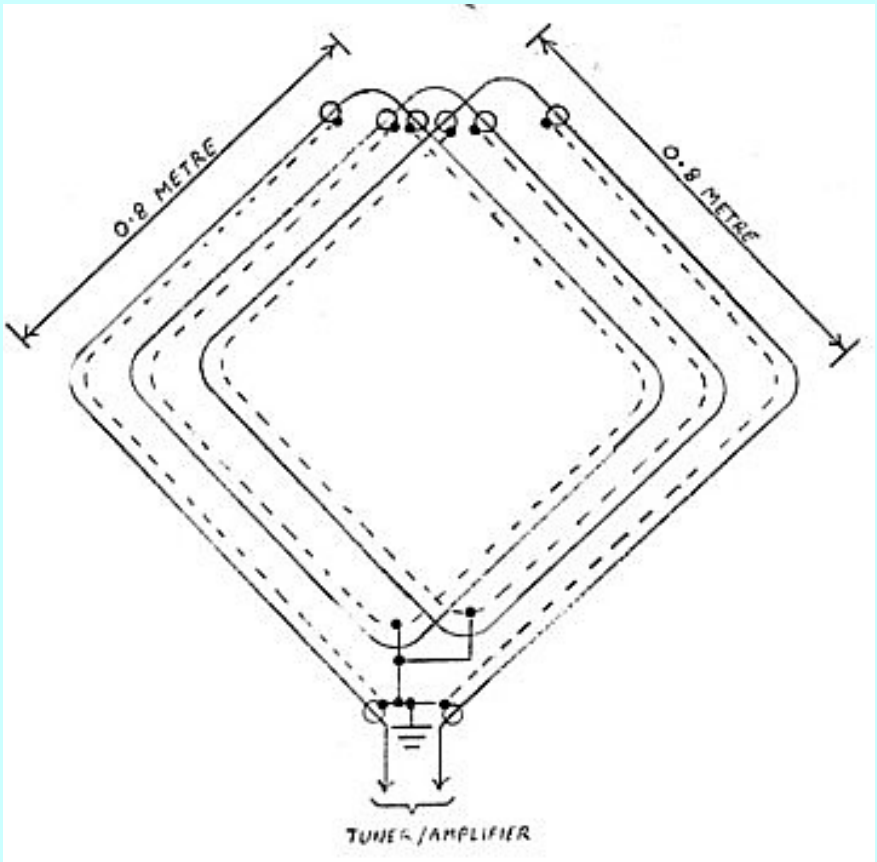
Es/e = (2nNAQ)/lambda

where Es = Output Voltage from loop
e = Field strength in Volts per metre
N = Number of loop turns
A = Loop area in square metres
Q = Loop Q factor
lambda = Wavelength in metres

Three-Turn Loop

Comparing the 0.8m square loop to the larger VK5KI, loop, the area is only 0.64 square metre compared to 6.2 square metres for the latter.This reduction factor of around 1:10 means a loop sensitivity loss of around 1:10, but this can be partly compensated by increasing the number of turns. However, increasing the number of turns also increases the inductance of the loop and its inherent shunt capacitance thus reducing the loop natural resonant frequency. This frequency must be higher than the operating frequency (1.8 MHz) otherwise it cannot be tuned to the operating frequency.

Three coax turns of 0.8 metre square appeared to approach this limit, and an experimental 0.8m square loop was assembled with three turns of 75 0hm TV coax. There was no particular reason for selecting this type of coax except that I happened to have a piece just the right length! The construction of this aerial is illustrated in figures 1 and 2. Observe that the outer braids of each of the coax turns are broken at the apex of the loop, and all braids are joined at the base of the loop. The square loop is oriented with its diagonals vertical and horizontal. The reason for this is that it is convenient to mount the loop interface box, with its connection to the loop, on one of the crossed pieces of wood which support the loop. It also makes it convenient to hang the loop from a hook in the wood at the apex.



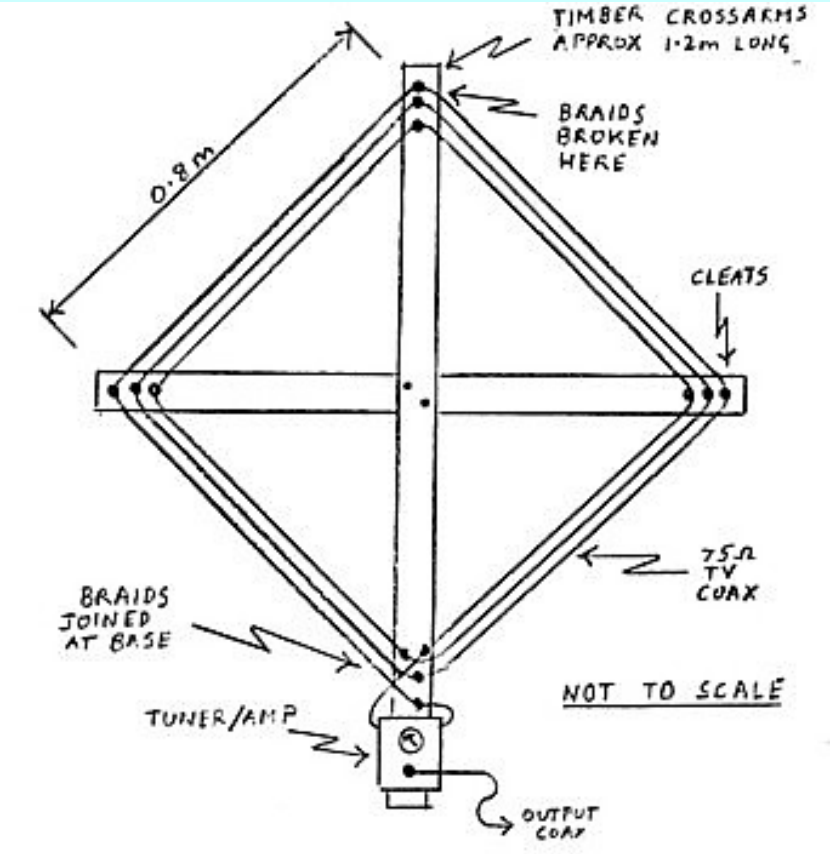


Figure 1 - 3 Turn Coax Loop Aerial Circuit Diagram

Figure 2 - 3 Turn Coax Loop Aerial Assembly

The increase in the number of turns of three to one does not fully compensate for the loss of 1:10 in area. However, the smaller three-turn loop measured a Q factor of 54 compared with 16 for the larger one-turn loop. The net result of all this was that loop sensitivity (Es/e) calculated as 3.9 for the smaller loop compared with 3.7 for the larger loop. Hence their performances could he expected to be much the same.

The natural resonant frequency of the three turn.loop was found to be around 3.5 MHz and well above the 1.8MHz operating frequency. It is possible that four turns could also have provided a natural resonance above 1.8 MHz, with a possible further improvement in sensitivity. However, this was not checked out.

Unshielded Loop Aerial

Theory on how a shielded loop aerial reduces localised noise interference was given in my earlier article on loop aerials for VLF-LF (Reference 1). If localised noise is not a problem, loop sensitivity can be improved by not shielding the loop.This reduces the loop self capacitance and hence the number of turns for a given upper frequency limit can be increased. I found that seven turns of lightgauge hook-up wire, spaced 5mm apart on the 0.8m square frame, produced a natural resonance of 2 MHz, just conveniently above the 1.8 MHz required. The Q factor at 1.8 MHz measured 39 and loop sensitivity calculated to a value of 6.5, which is very close to a value calculated for a 10m high vertical aerial.

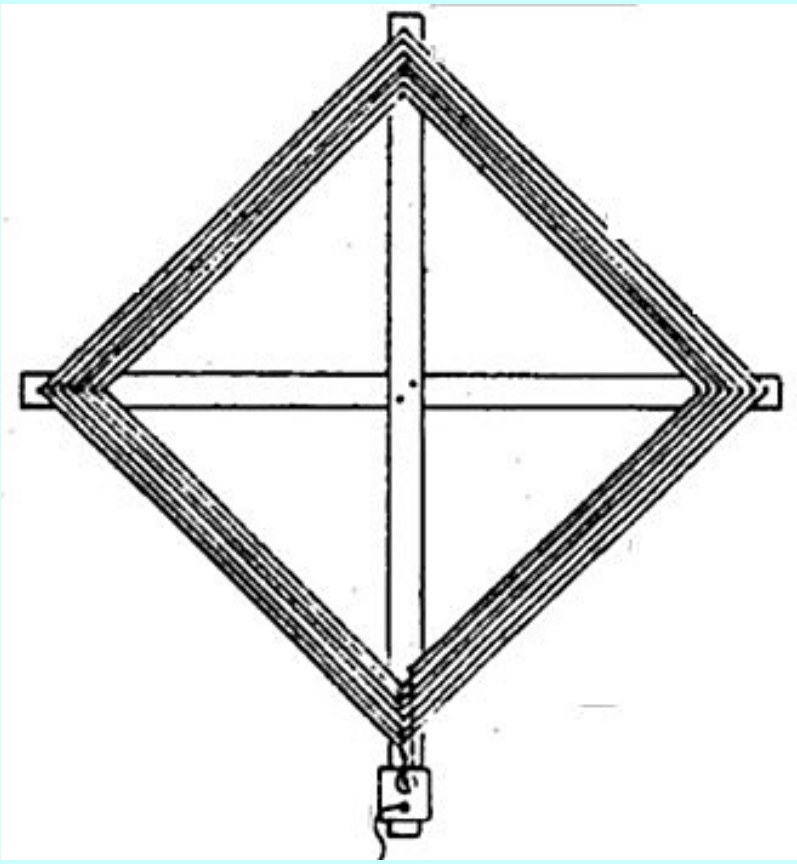


Figure 3 Unshielded Loop Aerial

Conductor Size

As we have discussed earlier, the loop sensitivity at resonance is directly proportional to its Q factor which, in turn, is the ratio of its inductance to series resistance. The resistance is the sum of radiation resistance and the AC loss resistance in the loop, the latter being the prominent factor as the value of radiation resistance is very small. The AC loss resistance can be reduced by increasing the surface area of the loop conductor.

The original seven-turn unshielded loop was wound with 0.4mm diameter wire and produced a Q factor at 1.8 MHz of 39. The wire was ultimately replaced with a 1.7mm stranded conductor to improve the Q. A side effect in doing this was an increase in the selfcapacitance of the loop, making it barely possible to peak the loop tuning at 1.8 MHz. To correct for this, the inductance was reduced by reducing the number of turns to 6.5 or, more correctly, one of the seven turns was returned from halfway around the loop across one of the crossarms so that the one turn had half the area of the others. The larger diameter conductor increased the Q factor to around 100. It would have been higher had it not been limited by the 200 kOhm input resistance of the interface amplifier. Correcting for the reduced area of one turn and the increase in Q, the loop sensitivity (Es/e) was derived as a value of 15.6, considerably higher than the 6.5 derived for the 0.4mm conductor.

In all fairness to the original VK5KL large single-turn loop, I must point out that this was made with RG8 coax, which has an inner conductor diameter around 2.2min compared with the smaller diameter 0.8mm conductor in the coax used for my tests. The Q factor of the VK5KL loop might well have been much higher than I have quoted and hence its sensitivity greater. It also follows that I could have achieved higher sensitivity in my three turn coax loop had RG8 been used. However, it is assumed that relativity between the signal sensitivities of the two shielded loop

forms tested would have been much the same had the larger cable been used in each..

Loop interface

To obtain the best advantage of the high Q factor of the loop (and hence its highest sensitivity) the loop is tuned to resonance at the operating frequency and connected via a high impedance input interface circuit. For the experiments described, this was achieved with the circuit shown in figure 4.

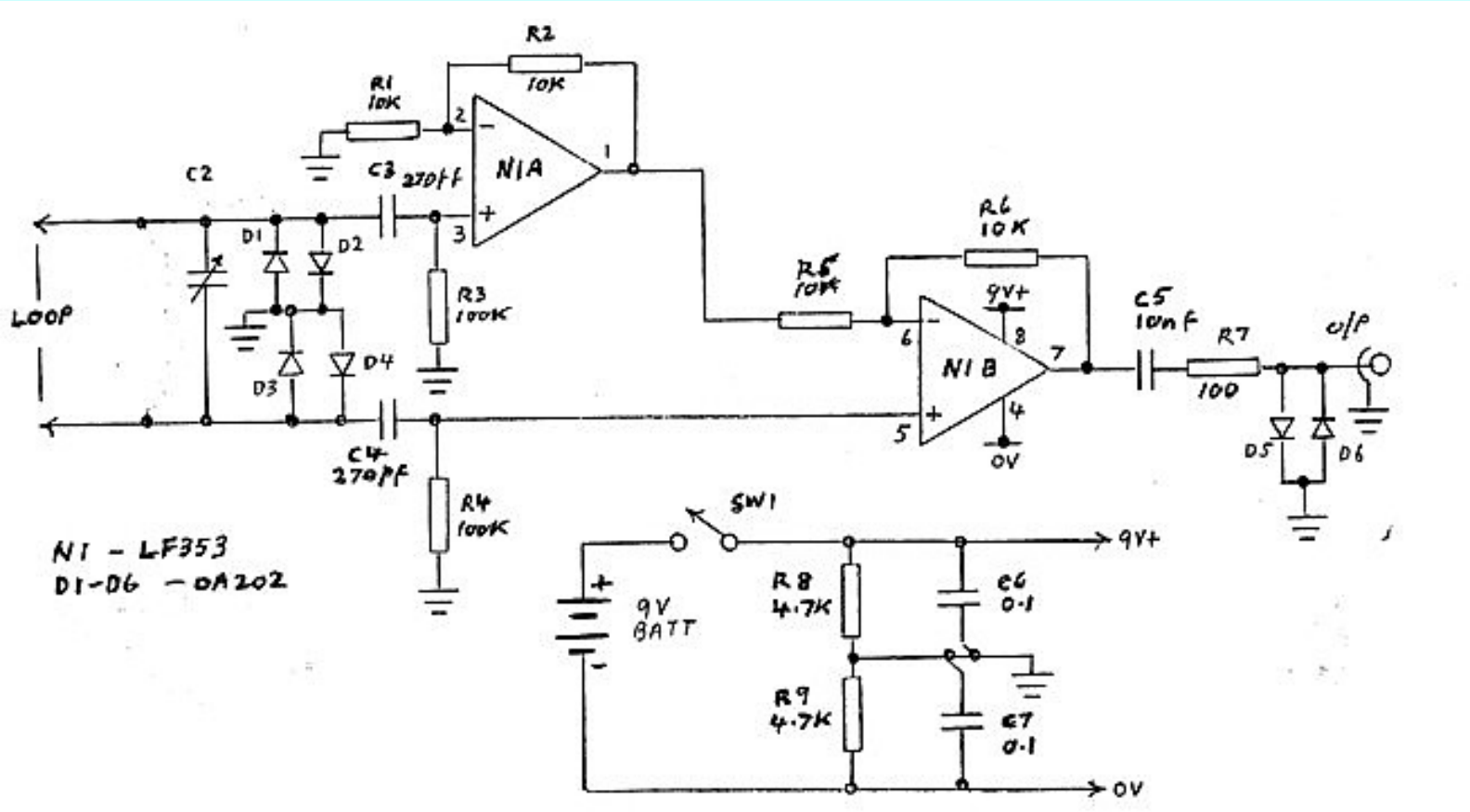


Figure 4 Loop Tuner and Interface Amplifier
For 6 & 1/2 Turn Loop, C2 is 3-56 pf miniature variable Capacitor

The circuit makes use of twin JFET amplifier package type LF353 connected for balanced input. For the benefit of those who might not be quite familiar with operational amplifier theory, we will examine the stage gains. In the amplifier circuit around N1B, the gain via the inverting input is defined by the ratio R6/ R5 and since R5 and R6 are equal, the inverting gain is equal to -1. However, the gain via the non-inverting input is defined by the ratio R6/(R5+R6) and hence the non-inverting gain from the lower loop connection in the diagram is equal to 2.

The other loop connection is fed via the non-inverting input of N1A. As the circuit around N1A is identical to that around N1B, it also has a gain from the non-inverting input of 2. Since this connection of the loop is in anti-phase to the other connection, its signal via N1A must be inverted in mixing with the other signal in NlB. This is done via the inverting input of N1B without change of amplitude.

The loop aerial output is equally shared between the two amplifier inputs and hence the overall gain, balanced to unbalanced, is 2 or 6dB. This is about the limit one can get from the LF353 package at 1.8 MHz as its gain-

bandwidth product is 4 MHz.

Tuning of the loop is set by variable capacitor C2 and, where necessary, parallel fixed capacitor Cl. The input circuit resistance is 200 kOhms, set by R3 and R4 in series. This is sufficiently high to prevent the loop Q from being lowered excessively.

The output resistance is largely set by R7, included for stability. Operational amplifiers can be very temperamental if operated directly into a capacitive load (such as a coaxial cable) without some series resistance.

The multitude of diodes at input and output are protection against excessive RF signal which might happen to be fed in. At the home installation, the loop aerial amplifier was connected via a switch into the receive side of the transceiver transmit/receive relay. This provided an interlock to prevent feeding the transmitter directly into the loop circuits. However, there was still a concern about RF induced from the transmitting aerial back into the loop and hence the diodes were included.

The amplifier circuit provides a very high impedance to low impedance conversion without loss of signal voltage developed by the loop Q.

Ferrite Core Loop Aerials

A further exercise was carried out to compare the performance of the loop aerial wound on a ferrite rod with that of the larger air-wound loops. Whilst this type of loop aerial has a very small loop area, the loss in area is compensated by the large number of turns which can be used and a high multiplying factor determined by the ferrite material permeability. For the aerial oriented to give maximum signal, the loop sensitivity formula is expanded to the following:

Es/e = (2nNAQu')/lambda

Where u'= The corrected permeability

Permeability requires some explanation. Permeability (u) of the material is the multiplying factor which applies to the inductance of the winding compared to when it is air wound, assuming all lines of magnetic flux pass through the winding. In the ferrite rod, not all lines of flux pass through the winding, so there is leakage flux. The inductance is therefore less, and a multiplying factor called rod permeability (ud) applies. Curves relating rod permeability to material permeability, for different rod length to diameter ratios, are published in the ARRL Antenna Handbook (reference 2) and in Amidon Associates brochures.

The corrected permeability (u') is the multiplying factor applied to the loop formula. If the coil winding is the full length of the ferrite rod, then corrected permeability is equal to rod permeability. If the rod is longer than the winding, the corrected permeability is increased as follows:

u' = urod x cube root(a/b)

where a = Length of the rod
b = Length of the winding

To carry out my tests, 1 purchased a ferrite rod (Cat L1401) from Dick Smith Electronics. The rod dimensions are 20cm. long by 9.5mm diameter. No information seemed to be available on permeability, hence the rod permeability was derived by calculating the ratio of inductance, measured for a given number of turns on the rod, to that for the same sized winding in air. The inductance in air was determined by two different methods which gave much the same answer. The first method was to apply the well-known Wheeler's formula for air-wound coils which can be found in many handbooks. The second method was to wind the same number of turns on a length of bamboo which happened to have the same diameter as the rod, and the inductance of this coil was then measured. The value of rod permeability was determined as 74, and from the curves previously mentioned, material permeability appeared to be around 120.

To operate at 1.8 MHz, 64 turns of 0.44mm single-core PVC-covered wire were wound around the ferrite rod. For this number of turns, the maximum which could be achieved, self-resonance was just above the 1.8MHz band at 2 MHz. The 64 turns occupied 7cm of the length of the rod and, from this measurement, a corrected permeability of 81 was derived.

The Q factor of the loop at 1.8 MHz was measured as 57, and loop sensitivity was calculated as 0.86, considerably less than all the air-wound loops discussed.

Comparison of Loop Sensitivities

The characteristics of the various loop aerials discussed are compared in Table 1. Despite its smaller area, the 0.8m square coax loop (B), with more turns and higher Q, has a signal sensitivity as good as the larger single-turn coax loop (A). With a self-resonance at 3.5 MHz, well above the required frequency of 1.8 MHz, it is probable that the sensitivity of (B) could have been improved further by adding another turn, still being tunable to 1.8 MHz.

The additional turns made possible by not shielding the seven-turn loop (C), enabled a higher signal sensitivity to be achieved comparable with that of a 10m vertical aerial (F). The importance of using a large sized conductor to reduce AC resistance is shown by comparing aerial (C) with aerial (D), which is similar to (C), but which has a large diameter conductor. The sensitivity of (D) is considerably higher than that of (C).

The ferrite rod loop aerial (E) works quite well because of the high permeability of its core, but it is no match in terms of signal sensitivity when compared with the larger air core loops.

Operational Performance

With the various loop aerials connected in turn to a receiver, the relative signal levels received followed much the same pattern as loop sensitivity shown in Table 1. Signal levels received on the three turn coax loop were comparable with those received on a sloping wire Marconi aerial loaded for 1.8 MHz and normally used as the transmitting aerial. The unshielded loops, with more turns, delivered considerably higher signal levels than the sloping wire. Some of the extra level is due to the 6dB gain in the interface amplifier but, even taking this into account, there was still quite a level difference.

Quite apart from the ability of the loop aerial to reduce interference from a localised noise source, its directional properties can be used to improve the signal-to-noise ratio in the presence of atmospheric noise. This particularly

applies if the noise has a directional property and the loop is oriented so that its null position faces the direction of maximum noise. Of course, the same technique can be applied to a source of QRM. For these applications, the unshielded loops, with their higher signal sensitivities, seemed to work best and they clearly improved the readability of signals otherwise difficult to copy on the sloping wire.

One would expect that the coax loop aerial would be more suitable than the unshielded loop in an environment of high local noise. Notwithstanding this, the seven-turn unshielded loop did not appear to be any more sensitive to localised noise which was introduced in the radio shack.

In actual fact, the unshielded loops could be expected to have quite reasonable rejection of the electric field component when operated into the type of interface amplifier circuit used. The electric field component of localised noise is the one which is the highest level and this is induced into the loop in a common mode with equal voltage at the loop output terminals referred to ground. The amplifier has a differential input circuit and hence the electric field component is essentially balanced out (see footnote). If the balance is good, there would appear to be a lesser need for electrostatic shielding to reduce localised noise.The additional shield might be needed more in using the loop for accurate direction finding (DF) work where a small amount of pick-up as a vertical aerial (called vertical or antenna effect) could make an error in the position of the signal null.

The ferrite rod loop aerial has an advantage in its small size and suitability for portable applications. However, its performance when connected to a receiver did not match that of the 0.8m square loops.

Conclusions

The performance of 0.8m square loop aerials for 1.8 MHz has been discussed. It is concluded that a three or four-turn coax loop aerial of this size would work as well as the larger single-turn coax loop aerial. The discussion has also extended to experiments with the ferrite rod loop aerials. As stated earlier, the aerial has its limitations.

By using a loop of unshielded turns to reduce the capacitance, the number of turns and hence the loop sensitivity, can be increased. Provided that the unshielded loop aerial is operated in a balanced mode, rejection of localised noise is still quite good. Loop sensitivity is dependent on its Q factor, and to achieve a high Q, the conductor size, or at least its surface area, should be as large as practicable.

Provided that the loop circuit is well balanced, I see little point in shielding the loop unless accurate DF work is envisaged. Some texts describe a step down coupling transformer to interface the loop to the receiver input. As a preference, I favour the use of the high impedance amplifier for the following reasons: Firstly, the transformer reflects a load from the receiver input and this must lower the loop Q. Secondly, the transformer provides a high-to-low-impedance transfer with step down of voltage. The amplifier does this as a voltage follower, or even with voltage gain. The only precaution is that the amplifier must be selected for a noise level below that received expected from the loop. The higher the loop sensitivity, the less is the chance of this being a problem.

My recommendation for a good performance 1.8MHz loop aerial, small enough to operate both inside the radio shack or outside, is six or seven turns of a heavy gauge copper wire spaced 5mm to 10mm on a 0.8m square frame (See Figure 3). As an alternative to ordinary wire, one might consider connecting up the outer braid of the old style heavy shielded wire or some discarded coax cable. Connect via the interface amplifier of figure 4. Use an input tuning capacitor 3-56pf (miniature variable). The amplifier is mounted at the base of the frame to keep short connecting leads to the loop.

1. Lloyd Butler VK5BR - VLF-LF and the Loop Aerial. - Amateur Radio, August 1990.

2. C H Castle VK5KL - A l0 ft Diameter Receiving Loop Aerial on 1.8 MHz - Amateur Radio, March 1982.

3. The ARRL Antenna Handbook 15th Edition 1988 - Chapter 5, Loop Antennas, and Chapter 14, Direction Finding Antennas.

Footnote

I have pointed out in the text that when the loop is connected via the differential input circuit the electric field component is induced in a common mode against earth and is essentially balanced out by the circuit. This should be qualified as being conditional on the loop dimensions being small compared with a wavelength. If the plane of the loop is in line with the direction of signal, a phase difference must exist between the voltages induced into each side of the loop. This will develop a differential voltage between opposite sidewires of the loop. In the loop aerials discussed, the distance between the sides of the loop is 0.8m, small compared with a wavelength of 160m. Hence, the phase difference is small and the voltage generated is also assumed to be small.

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Posted on rec.radio.shortwave

SHORT & EASY MEDIUM WAVE LOOP ANTENNA

From: Ron Hardin
Date: Tue, 01 Jul 1997 15:15:15 -0400
Organization: AT&T WorldNet Services
Newsgroups: rec.radio.shortwave

Short and easy MW tuned loop construction, with Radio Shack parts:

Build an 18" square wooden frame, 2" wide, to wrap wire on;
wrap 14 turns of thin insulated solid copper hookup wire around it
(buy 100' of say #22 insulated wire, $5.00), spacing it out, and attach
the ends to the leads of a variable capacitor. (You can extract the variable
capacitor from a Radio Shack crystal set kit $8.00) Duct tape the capacitor
to the wooden frame of the loop.

Done!

Place a radio inside the loop, tune to a station, and wiggle the capacitor
knob for maximum; there's an amazing increase in signal strength DURING THE
DAY. There's not much effect seen at night because the signals are already
too strong.

If the capacitor is too noisy when tuned (you have to wiggle for a sweet spot)?
You could get a real one from an old radio, or buy one also at Radio Shack.
The variable capacitor should be 365 pf or higher value.

Removing a turn of wire raises the frequency range of the loop; adding
a turn lowers it. The thing tunes slightly less than the whole band,

This at least gets you started and you can see what you'll get.

You can also turn this into a crystal set by adding a high impedence
earphone, and a diode. Wire the earphone in series with the diode and
place these in parallel across the capacitor/loop.

--
Ron Hardin

- Back to the DX News and information page
- Back to the Utility News and Information page

LOOP DISCUSSION!

- Back to the SPEEDX Shortwave and DXing Home page

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How to Get Better AM Radio Reception

Last updated March 7, 2003.

Introduction

AM radio offers challenges for good reception. It is more susceptable to various kinds of interference, both natural and man-made, and sometimes it's hard to find a radio that gives you decent AM reception. But I enjoy many stations on AM for the programming they offer, and have searched out ways on my own to get better AM reception. I will share them with you here.

I've spent considerable time searching the internet, and haven't found a web-site devoted to helping the average person get better AM radio reception. I hope this web site fills that need, and offers some help. I've tried to keep this as non-technical as possible. Also, please remember that any reference I make to any specific product is my opinion, and that it is your responsibility to be a careful consumer. Shop carefully, whether on-line or in person, and be aware of the seller's return policy (just in case) and any product warranties. :-)

AM Radio Reception

The Antenna is 90% of Your Radio

Who ever thinks about the antenna for AM? Yes, for FM you have the rod antenna that you pull up and move around, or that piece of wire that came with your stereo that most people leave dangling in a tangle behind the entertainment center (then wonder why their FM reception is no good...).

Your AM radio has an antenna, too. In most portables, transistor radios, boom-boxes and table radios, the AM antenna is built in. It consists of a ferrite rod around which is wound thin wire. Since we don't see this antenna, we tend not to think about it, but it's there nevertheless.

This antenna is directional-- that is it picks up signals from some directions better than others. This built-in antenna is best at picking up stations coming in from a direction perpendicular to the rod. It is least sensitive picking up signals coming at it end-on. This phenomenon can be used to your advantage. To get a station in better, try turning the radio. By doing so, you are aiming the antenna inside for a better signal. And if there is interference, you may be able to get the antenna rod pointed end-on toward the interference, thereby reducing it or cutting it out completely.

What if you have a nice stereo system, with a receiver or a rack system? In those cases, the AM antenna is often a loop of wire wrapped around a small plastc frame that you connect to AM antenna terminals on the back of the stereo. Let's hope you didn't throw this away with the packaging. If you did, get a length of wire, maybe 20 feet or so, and wrap it around something non-metallic to make your own loop. You might try using a cheap plastic food dish, for example. Wind it around its circumfrence, then strip the ends of the wires and connect them to the AM antenna terminals. As with the ferrite rod described above, it is directional, so experiment with the correct placement.

Many old stereo tuners and receivers had the ferrite rod antenna mounted to the back of the cabinet on a hinge. Again, experiment with aiming it for the best results.

Buying a Better Antenna

Still need more signal? Try a better antenna. I'll tell you up front, sometimes this isn't pretty. And it can be dirt-cheap, or very expensive. Sometimes when you walk into the local electronics store and ask for a better AM antenna, the sales clerk will look at you like you have 2 heads. But don't give up. Take a print-out of this sheet and stand your ground.

- ## The Cheap, But Effective Long Wire

  The old fashioned long-wire antenna may work for you. But to use it you need two things:

  - An AM antenna terminal on your AM radio, and
  - Some place you can string up 50-75 feet of wire

  If you can't do this, read down for ideas on indoor antennas.

  The long-wire antenna is simply a long copper wire strung between two high places, with a lead-in wire going to the AM antenna terminal of your radio. RadioShack sells these items as a pre-packaged kit (catalog #278-758, $9.99 in their 2000 Catalog.) I have provided instructions on building a long-wire antenna on a separete page.

- ## The RadioShack Indoor AM Loop Antenna Catalog Number 15-1853

  This is an attractive loop, about 12 inches in diameter, with a tuning knob. "Fully adjustable antenna electrically matches specific AM frequency you are trying to receive..." You put it next to your radio, tune the knob for best reception. It couldn't be easier! There's an antenna jack on the

back for hookup to AM antenna terminals if you have them. (RadioShack catalog # 15-1853 $29.99 in the 2000 Catalog)

- ## The Terk AM Advantage, Model AM-1000

  Terk makes an indoor loop antenna for AM radio. It is a 12" loop that is very attractive, and can sit next to your radio. As with the RadioShack antenna above, you put it next to your radio, tune the knob for best reception. It couldn't be easier! There's an antenna jack on the back for hookup to AM antenna terminals if you have them, and it comes with a short cable for that purpose. I bought one myself for $50 at a local stereo store. Look around, ask, and see if someone can order it if they don't carry it.

- ## The Select-A-Tenna

  This is another tunable loop like the Terk AM-1000, but is reputed to be even more powerful. I haven't personally tried this one, but I has a good reputation. It comes in several versions, one of which includes a regerative amplifier to really boost reception. It is available by mail-order from:

- The C. Crane Company Based in California, they specialize in things for listening to radio. They have an on-line catalog.
- Universal Radio a company specializing in products for Amateur (Ham) Radio operators and shortwave radio listeners.

- ## The Kiwa Loop: Very expensive, very nice.

  The Mother of all AM Antennas. I wish I had the $350 bucks for this one. If you do, again you can get one from:

    - The C. Crane Company
    - Universal Radio

  This is an amplified tunable loop antenna that can be aimed both in the horizontal and vertical planes. It uses what is called a "regenerative amp" to take a small amount of signal and boost it to usable levels. In the process, it also increases the selectivity of your radio (the ability to "zero in" on a signal stuck between two others on the dial). This antenna is intended for people who are dead serious about their AM radio, and use a high-quality communications receiver, although theoretically one could use it with the RadioShack 12-603 or the GE Superradio III or even a good stereo receiver, since they have antenna terminals. I've seen pictures and read articles about this antenna. A couple of technical friends of mine drool over this, and they hope that their ship comes in someday so they can buy one. So do I. But like I said, it costs over $350.00! Be very careful to

ask about the seller's return policy on this item, especially since it is special order!

Sources of Interference

But the antenna is only the start. You also have to deal with interference. AM radio is more susceptable to natural and man-made interference due to the way the signal is carried over the air and demodulated (or "decoded") in your radio. The following things can cause interference on your AM radio:

- Florescent lights
- Nearby businesses with neon signs, or lots of florescent lights
- Light dimmer controls (including your neighbor's if you're in an apartment)
- Touch lamps (the kind you touch to turn on or off)
- Television sets
- Computers and computer monitors
- Electric motors
- Dirty or faulty insulators on nearby electrical utility poles
- Radio equipment or medical equipment in your neighborhood (such as a nearby police station, hospital or clinic)
- Microwave ovens
- Electronic Bug Zappers and Electronic Pest Controllers
- A lightbulb that is about to burn out
- Automatic lights (indoor or out)
- Hard-wired smoke detectors
- Blinking lights (such as Christmas lights)
- I've even gotten interference in my car from traffic light controls, and also every time I drive past a police station (they have electronic equipment in there that cause interference).

The idea is to shut off any sources of interference that you can. Sometimes this is difficult, as you can't ask the bar next door to shut off its neon sign. But control whatever interference you can.

Sometimes moving the radio to a different location, or even turning it (so the internal antenna is aimed in a different direction) may be enough to reduce or eliminate interference, yet still leave enough signal to listen to the station you want.

If you are not sure where the interference is coming from, get a battery operated radio. If the interference disspears, then it was coming through the AC power line. RadioShack and other retailers of electrical parts and accessories sell AC Line Interference Filters that can reduce this kind of interference. If the interference does not go away, then it is coming through the air.

If this is the case, use the battery operated radio as a "direction finder" to locate the interference. Tune to a weaker station, and walk around with it until you come to where the interference is strongest. If it turns out that the interference is strongest near a utility pole, call the electric company, and see if they'll come out to wash or repair the insulators on the pole. Otherwise, you have the source of the interference, and if it is something you can control then you're all set. **Caution!** Do not mess with electrial circuits or devices unless you are a qualified technician. Leave that to the professionals as it is dangerous.

Radios that are Good for AM.

Unfortunately, AM radio is often an afterthought when they're designing home entertainment products. It's a sad fact that the $2000 super-duper surround sound system you just bought probably has an AM section no better than a cheap clock radio, if it's even that good! Maybe manufacturers believe there's no demand for a decent AM section, though the fact that you're here reading this is probably proof that their wrong! (There are a very few exceptions, McIntosh being one that comes to mind, but their stuff is mucho-mucho expensive!)

Still, if you care about your AM reception, there are a some portable radios out there that do a good job at receiving stations. The products I mention here are the ones that I know about costing less than $100 (with one exception at $159.95). Although there may be others that also do well, I haven't been able to evaluate them myself. Remember, your results may vary, as reception is different for everyone, although I would suggest that if these radios cannot pick up the station you want when used with a good antenna, it may not be possible.

As with anything you buy, always ask about the return policy of the store or dealer and ask about the warranty *before* you buy, in case you need to return it, or have a problem. RadioShack's ESO - "Extended Service Option" is available on many of their products, and is a good deal. RadioShack's policy with their ESO is usually to forget the fine-print and make the customer happy. Always save the receipt and packaging, no matter where you buy! Be a smart shopper!

- ## RadioShack High Performance Radio (cat# 12-903, $59.99 as shown on the RadioShack web site.)

  I reviewd the now-discontinued version of this radio, the 12-603. I have not had an opportunity to thoroughly evaluate the new version, but after a short evaluation I believe it to be essentially the same radio with cosmetic changes.

  Most radios under $100 give you mediocre reception, but this is one radio that excells! It's called the Radio Shack High Performance Radio. It is specifically designed for people who want good

AM reception. It has a good built-in antenna and high performance tuning sections that provide great reception and sound. It has a bandwidth switch for AM that allows the radio to narrow the "reception window," to use a non-technical term, so you can zero-in on a station and cut out interference from stations on either side on the dial. You can also switch to Wide mode to open up this "window" and get better sound quality when there's no interference. In Wide mode the sound quality is so good that with a strong signal, your friends will think you've tuned into FM!

It has terminals on the back for both AM and FM antennas (which is rare on portable AM/FM radios). It has nice sounding built-in speakers, using a 5" woofer for good bass and a tweeter for clean highs. The sound quality is very nice, no matter what kind of music or programs you enjoy. It also gets good FM reception. It runs on batteries or AC. It is similar to the GE SuperRadio III, and is rumored to be made by GE with the RadioShack name on it, but this cannot be oficially confirmed and I have heard there are actually some significant differences between them. I know the speaker is smaller, and the ferrite rod antenna may also be shorter. I have not verified the latter difference personally. It's sold and warrantied by RadioShack.

The list price is $59.99 as of 03/07/03, and it goes on sale every once in a while.

- ## The GE SuperRadio III

This is the most well-known high performance AM radio currently available. It is the one that the RadioShack version is based upon. There are those who say it out-performs the RadioShack version. I have not personally verified this. This is the Mother of all AM Portables. It has a very good built-in antenna and high performance tuning section that provides great reception and sound. It also includes a bandwidth switch. This switch can be set to "narrow" to zero-in on a station and cut out interference from stations on either side on the dial, or switched to "wide" to open up and get better sound quality when there's no interference.

It has antenna terminals on the back for both AM and FM (which is rare on portable AM/FM radios). It boasts a powerful amp, and a big 6" woofer for good bass and a tweeter for clean highs. It sounds as nice as a decent boom-box. It gets good FM reception, too. It runs on batteries or AC.

The price varies. I've seen it at some places for $59.95, and other places for less. I recently saw one at Sears for $49.99.

- ## The CC Radio

The CC Radio, manufactured by Sangean for the C. Crane Company is designed specifically for AM Radio listeners. (It also includes FM, TV Sound and the Weather Band with alert.) I have not tested this radio personally, but have read some excellent product reviews in some major magazines, and it has been reccomended by a visitor to this web-site. The published specifications

look good. It is reported to be very sensitive and selective (meaning it can "zero in" on a station located on the dial between two other stations). The sound quality is tailored to the range of the human voice, making it great for listening to talk shows and news from distant AM stations. It sells for $159.95 (as of 05/27/2000 in their magazine ad), including shipping. Yes, a bit expensive, but remember that this is a specialty product designed for someone who really wants good reception. It includes antenna terminals, and is reported to perform well on FM as well.

Is there a strong signal in your area?

Know When to Hold 'Em, Know When to Fold 'Em: You can't hear what isn't there.

Everything I write from here on down assumes that you have already have a decent AM radio and antenna, but even if you don't, or can't use a good antenna for whatever reason, the following information is still important.

- **Daytime Stations** and **Reduced Night-Time Power** If your favorite station is a small daytime only station, you won't be able to receive it after sunset. While this may seem obvious, you would be surprised at how many folks come to me because they can't pick up a particular station at night, and it turns out to be a daytimer. Some stations don't go off the air altogether, but reduce their power to very low levels, and can't be picked up more than a few miles away after dark. If you are not sure if your favorite station shuts down or reduces power at night, you can call the station, or check the station databases I have links to on the main radio page.

- **Small Transmitters** Sometimes an AM station station may be broadcasting with low-power, and just not reach your location. While having a good radio and antenna is important, there has to be some signal in the air for your radio to pick up to begin with. Again, many people don't realize this is the case.

- **Directional Transmitter Antennas** Many radio stations have directional antennas; that is, they concentrate the signal in one direction or towards a particular geographic area. This is often done to prevent interference to other staions in the area, or to concentrate the signal where the greatest number of people may live. For example, the huge 50,000 watt WBZ near my home town has an antenna that beams the signal west-- which makes good sense, since there is no point in wasting power broadcasting out over the Atlantic Ocean! Likewise, the little college FM station that I was on (Oh! Those carefree college days!) beams it's signal to the south, to avoid interfering with another station close on the dial to the north of us. AM stations do this also. One local AM station

in my area has a directional antenna that beams half the signal over the ocean, and the other half clean across some of the finest undeveloped woodland in the state. What were they thinking? As a result, hardly anyone can get it. Local radio engineers joke that they are "feeding the fish."

This sometimes explains why your friend who lives the same distance in miles from the station, only a few towns over, can get the station while you can't. It may be the station's antenna is aimed at his or her town, and away from yours. So, try to determine where you are in relation to the station's transmitter-- not just in terms of distance, but also in terms of direction? Again, a call to the station or search on the databases I've linked to may answer this question for you.

- **Obstructions between You and the Transmitter** An obstruction between you and the transmitter, such as a mountain or tall buildings sometimes blocks the signal. And as I explain below, the construction of your house or office may block AM radio waves.

- **Where is the transmitter?** Sometimes the transmitter is located in a different city from the studio. For example, the transmitter for 680 WRKO Boston, Massachusetts is a few miles west of the city in a town called Burlington. And the transmitter for 1030 WBZ Boston is a few miles to the south-east in the town of Hull, Massachusetts. Getting certain "Boston" FM and AM stations I like is a challenge as many are located as far as 25 miles north of Boston! (And I, obviously, live 30 miles to the south.) Those extra miles can make a difference. Just because a station says on the air that they're in "Your City" doesn't mean much for reception becasue their transmitter and antenna may be in "East Overshoe." Why do they do this? Well, first of all, where are you going to put up four 500 foot tall antenna towers in the middle of a city, and second, the prestige of being associated with a bigger town or city lends to the station a certain air of authority that can attract advertising dollars. Hence, stations petition the FCC to allow them to identify themselves as being where their studio is, in the city, rather than where the transmitter/antenna is, often way out there. Again, a call to the station, or a look at the on-line database will answer this for you.

- **Listening from inside Certain Buildings** Sometimes people can't get any AM reception in certain places, such as their workplace. I often hear this complaint. The building may be made of metal, use reinforced concrete walls (metal rods in the concrete to strengthen them) or have a metal roof. There may be computers or machines that cause interference, and hundreds of florescent lights in the ceiling. They may get no AM reception at all-- even on the huge 50,000 watt powerhouses. Unfortunately, there is not much one can do here. I always suggest putting the radio by a window, and the usual reply is that their desk or work-station is too far away from the window to do that, and they wouldn't be able to turn it up loud enough to hear it over the noise, or without disturbing their co-workers from that far away.

  If you can string an antenna to the outside of the building, try that, although again somethimes that's not practical. (C. Crane Company offers a version of the Select-A-Tenna for this application.) One customer of mine lived in a trailer-- a metal trailer, and couldn't get anything! He got the RadioShack 12-603 (mentioned above) and ran a wire outside from the AM antenna

terminal. Now he's happy as he can pull in even the weak stations. Again, that depends on what your situation is, and what the boss will let you do.

If this isn't possible, it may be time to consider using a cassette or CD player, and leave the radio listening for home.

Tape it, like you tape TV shows!

So you can't get your favorite AM station at work to listen to that talk show, or maybe you can't listen because of the nature of your job. So tape the show. One visitor to this web-site sugggested putting the radio and tape recorder (a boombox may work nicely here) on one of those light timers you can get for a few bucks. Tune in the station, press the record button then unplug it, plug into the timer, and set the timer. Of course, the longest cassette you can buy is 120 minutes, 1 hour per side, two hours if your cassette recorder auto-reverses. It's better than nothing. Also, a couple of the above mentioned companies offer special radio-recorders that can get up to 8 hours on a single cassette! They do this by modifying the cassette recorder so it runs the tape very slowly to fit 8 hours onto a 1 hour tape. Of course, these specially-recorded tapes can't be played on a regular cassette player, but a couple of these companies also offer also offer special personal tape players with headphones that will play the tapes. This way you can listen at your convenience.

Or, use your VCR. That's right, I said "VCR." An engineer friend of mine uses a HI-FI VCR to do this. He runs a patch cable from the headphone jack of the radio to the audio input on the back of the VCR, switches the VCR to the line-input (consult your VCR's instruction book on how to switch to this input) and has it record at the SLP (also called EP) speed so he can get 6 hours on a T-120 tape. Play it back through your stereo if the VCR is hooked up to it, or just use your TV (you'll hear the program but the screen will be blank, obviously). Although I haven't tried this with a non HI-FI VCR, it may still work. Not all VCRs can do this, but if you have one, try it! This feature may not be documented in your VCR's manual. Remember, for this to work, instead of using the external timer, you program the VCR to come on at the right time, and the radio is already turned on and tuned to your station. Again, for instructions on programming specific VCRs, consult your owner's manual. (Please do *not* e-mail me asking how to program your VCR! There are hundreds of models out there, going back nearly 20 years --how time flies! -- and I only worry about my own VCR and my Mom's. The rest of you, please read the manual, or enlist the help of your friendly neighborhood whiz-kid!)

Other Resources

RadioShack As they say, "You have Questions, We Have Answers!" They say that over 90% of the population lives within a 5 minute drive of a RadioShack. Plus, as you know from reading this, they have a lot of the stuff you need for better AM listening.

DX-ing.com A resource provided by Universal Radio for people interested in receiving long distance (hence, "DX") radio and TV signals.

The C. Crane Company offers information on their web page about getting good AM reception (in order to sell their products, of course, but the info is good).

Grove Computers and Radio A company offering products for better radio reception, also publishing the magazine "Monitoring Times," a publication for radio enthusiasts.

Better AM Radio Reception a page with some tips for getting better AM radio reception.

Return to the Radio Reception and Resources Page

Go to the Pilot of the Airwaves' Main Page for links to 80s Music, Humor, and assorted historical and serious things!

GeoCities
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Pages Like | Search | Send This Page | Forums

Yahoo! My Yahoo! Mail

YAHOO! Groups Welcome, **mikelob2003**
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Polls
Members
Calendar
Promote

(Already receiving group email?)

Description

Category: Shortwave

Welcome the GCC Loop Antenna Designers and Builders group, this list is everyone who likes to learn about all bands ELF, VLF, LF, MF, HF, VHF, and FM broadcast and UHF Loop antennas.
Contruction, tips, help, questions, and websites are welcome to the group. I hope this group will help. Also ferrite Loop Antennas here too. So get out the wood, magnet wire, variable capacitors, and don't forget the electrical components, and lets start sharing some tips, and ideas,questions about loop antennas.

In addition we can also talk about the assembled loop antennas; how to use a loop antenna; and modify a loop antenna to certian requirements. Some loop antennas to consider are the Select A Tenna, TERK AM (MW) Loop Antenna, Justice AM (MW) Loop, and directional loop antennas . Ham's, SWL, monitors, DXer's, everyone is welcome that is into using a loop antenna with their radio and receiver. Our discussion is based on loop couplers, loop antennas, commercially made loops, and your homemade loop antenna creations that cover SLF to EHF.

BTW: This group will not ever shut down, we are upgrading and getting more interesting projects here as well.

Join us! Leave a Post while you are at it,also share some suggestions, antenna projects with us. 73

Be sure to learn more and get more links and groups from this membership here! http://groups.yahoo.com/group/gccradiodxworld/ and

Group Info

Members: **1109**
Founded: **Feb 14, 2002**
Language: **English**

Group Settings

- Listed in directory
- Restricted membership
- Unmoderated
- All members may post
- Public archives
- Email attachments are not permitted

http://www.geocities.com/gccengineering/ and also
http://www.geocities.com/gccradioscienceobserver1978/intro.html
http://www.groups.yahoo.com/group/Radio-Science/
Be sure to check out upcoming projects, and other groups postings here, we invite everyone from all over the world to participate.

Also visit our groups here called For Your Interference Solutions from the Community http://groups.yahoo.com/group/gccradiodx/
For You Interested In Making A Ferrite Rod Antenna
http://groups.yahoo.com/group/FerriteRodAntenna/

What's New

New within the last seven days:

Members: **4** Messages: **1**

Recent Messages

View all Messages (2514)

RSS **Get messages in RSS** | Add to My Yahoo!

Sep 6 Increasing tuning range. - **electronicdx**

I have the old loop antenna, and I wanted to increase range with configuring th

Aug 30 Re: New Group - Central Electronics Collecting and Restoring - **radiohighfreq**

= = = In gccloopantennadesign@yahoogroups.com, ... keep getting a message that

Aug 29 Re: New Group - Central Electronics Collecting and Restoring - **wa1yqh0**

if there is a centeral electronics group i can not get into it ,i keep getting

Aug 29 correction -- to Central Electronic Collecting - **joeyjeepusa**

Hello everyone, I have created a new Yahoo group "Central Electronics." The gro

Aug 29 New Group - Central Electronics Collecting and Restoring - **joeyjeepusa**

Hello everyone, I have created a new Yahoo group "Central Electronics." The gro

Message History

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	147	150	436	138	221	249	113	43	1			
2003	22	39	44	18	15	130	77	108	108	76	70	139
2002		9	1	1	7	1	5	64	50	9	6	17

Group Email Addresses

For more information: http://www.groups.yahoo.com/group/gccradiodxworld/

Post message:	gccloopantennadesign@yahoogroups.com
Subscribe:	gccloopantennadesign-subscribe@yahoogroups.com
Unsubscribe:	gccloopantennadesign-unsubscribe@yahoogroups.com
List owner:	gccloopantennadesign-owner@yahoogroups.com

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www.ebay.com

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Yahoo! My Yahoo! Mail

YAHOO! Groups Welcome, **mikelob2003**
[Sign Out, My Account]

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Groups Home - Help

Start a Group - **My Groups**

loopantennas · Loop Antennas

[Join This Group!]

- **Home**
- Links
- Calendar

Members Only
- Messages
- Chat
- Files
- Photos
- Database
- Polls
- Promote

(Already receiving group email?)

Description

Category: Shortwave

Discussion of loop antennas on all bands including ferrite loops, air core, all types. All bands SHF, VLF, LF, MF, HF, VHF, UHF, etc. Shortwave, longwave, receivers, transmitters, all fair game here.

Trying to resurrect the old LoopAntennas list without the melodrama. Please post links, files, etc. Please write a good description of files and links when you post them. I saved all the links, we'll have to build up the archives again.

All new members are moderated until you post once or twice, or if I recognize you. Spammers will be handled with minimum fuss.

What's New

Nothing new within the last 7 days

Message History

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004						131	21	49				

Group Email Addresses

Post message: loopantennas@yahoogroups.com
Subscribe: loopantennas-subscribe@yahoogroups.com
Unsubscribe: loopantennas-unsubscribe@yahoogroups.com
List owner: loopantennas-owner@yahoogroups.com

Yahoo! Sponsored Links

Radio Batteries at Batteryjack: Deep Discount prices on Motorola, Bendix King, Kenwood, Icom, GE/Ericsson radio batteries and accessories at Batteryjack. Dealers welcome.
www.batteryjack.com

Group Info

Members: **219**
Founded: **Jun 7, 2004**
Language: **English**

Group Settings

- Listed in directory
- Open membership
- Posts from new members require approval
- All members may post
- Archives for members only
- Email attachments are permitted

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Equipment and Projects

ARES/RACES
Our Mission
Activation Plans
Projects
Local Nets
Events & Training
ARES Application
Net Control Script
EC Report

The following are some good emergency antenna projects to consider building. There are several reasons to consider building your own antennas for emergency work which include:

1. They are not expensive so if you loose them, or they get destroyed during the event you're not out big bucks!
2. You will gain a greater understanding of RF technologies especially antenna design.
3. You will learn how to improvise!
4. Last but not least, its fun!

Each antenna has a unique use. Please consider experimenting and playing! Share your success on the weekly nets as well!

Build a J-Pole for any frequency - Includes an Excel Spreadsheet!
Plans for a J-Pole

Pocket J-Pole
Half Wave J-Pole
Stacked 5/8
Field 2 meter Colinear
2 meter Colinear in PVC
2 meter Halo
Eggbeater Loop Antenna
HF Antenna Designs
Trickle Charge Circut

Off Site Plans

NVIS Short Range Antenna Systems for HF
NVIS Discussions
KB1DIG's Home Site
Copper Cactus Plans
N7QVC's J-Pole Plans
St. Louis Vertical (10-40m)
Windom - 6 bands in one antenna
Quickie Vertical- By KQ6RH
Wide Band Folded Dipole
Horizontally Oriented, Horizontally Polarized Large Wire Loop Antennas

Disaster Supply Kit

Being ready for an event or disaster requires preperation before the call comes. This means getting a supply kit together and knowing what is in it. We have included a article to help start your list.

Number of visitors:

n2njh@arrl.net
Buffalo, NY - USA
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This page was last updated on : undefined

How to Make the Ultimate AM Antenna

Carver Corporation of Lynnwood, Washington once made the ultimate AM Stereo/FM Stereo tuner, the Carver TX-11b. The performance of this tuner was nothing short of spectacular on FM; the AM side was even more impressive, as it was designed to have an audio bandwidth of 20 Hz - 15 KHz -- the same as broadcast FM!

In order to receive clear AM Stereo signals -- on the TX-11b or any other AM radio, however, you have to have a good antenna. So Carver gave a plan for making what they called "The Ultimate AM Antenna." Here are the plans for this antenna.

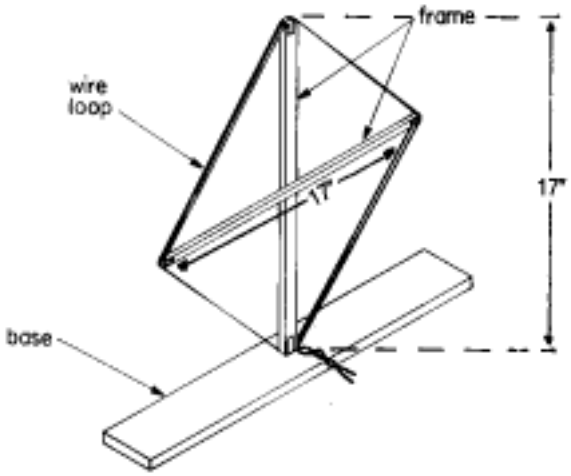
1. Construct a wood frame that measures 12 inches from point to point (17 inches across each bar).

2. Secure the frame to a base.

3. Wrap the frame with four turns of #22 insulated solid wire.

4. Twist the wire ends together approximately 2 turns per inch (I made a change here. On the base, I installed a two-wire terminal so I could easily connect a different length lead wire. I connected the ends of the wire from the loop to the terminal block and then connected a shielded wire to the terminal block to act as a lead-in. The ground (shield) lead connects to the ground terminal of the radio, the center wire connects to the "external AM antenna" terminal of the radio. You may have to experiment with your own radio to find what works best).

5. Strip wire ends and connect to the AM terminals on the back of the radio (unless you used my changed design in 4 above).



The idea is that the size of the antenna acts as a long wire antenna, but the loop acts as a local noise eliminator. I have found it to work quite well in the Los Angeles area, where at night I can often pick up very distant stations with ease.

Other ideas you may try are simple long wire antennas (good for distance or eliminating long-distance atmospheric noises) or if you are in an office that doesn't like the look of the "ultimate antenna," just placing a portable radio near a window.

Doug's Radio-Electronics Loop Antenna Page

Part 5 of a series on antennas appears in Radio-Electronics Magazine for June, 1983 on page 83. Its title is "All About Loop Antennas for VLF-LF."

I'll reproduce the text, but there are several illustrations that I can't duplicate. It would be worthwhile to find yourself a complete copy of the article. My copy is pretty poor and I can't even tell what's in many of the figures!

Added December, 2001 - I have recently found a better copy of this article and scanned it, complete with separate scans of the graphics. Go back to the Short Wave Radio Page and look for the link.

Perhaps the most important difference between loop antennas and the whip antennas that we have previously discussed is the loop's directivity. (The vertical whip is, of course, omni-directional and cannot indicate the direction from which a received wave comes.) Before we can talk more about this directive property, we have to take a look at how an electrical signal is induced in the loop by a passing electromagnetic wave, and at some general electrical characteristics of loop antennas.

Loop antenna characteristics

A current is set up in a loop antenna by a changing magnetic field. (That current is equal to the integral of the electric field that is induced around the loop.) The sensitivity of a loop is directly poroportional to the loop area and to the number of turns in the loop. It is, in general, inversely proportional to the wavelength of the signal. Small receiving loops for 60 kHz (WWVB) require a preamplifier with a voltage gain of 30 dB or more to make them comparable in performance to a small active whip antenna. [Ed. Note: notice the key word **'active'** here!]

The inductance of the loop winding itself makes loop antennas frequency-sensitive. Because of that, it becomes difficult to make such antennas with wide-band characteristics. To increase the sensitivity of a loop, multiple-turn coils are used at the VLF-LF range. However, the distributed capacitance of the windings acts with the loop's inductance to decrease the antenna's frequency response. That however, is not always a disadvantage. The frequency selectivity of a loop winding is often an advantage in that it can provide for rejection of out-of-band signals (in other words, it can form a sharply tunable antenna system). Loop antenna systems seldom have intermodulation-distortion problems because of their lower sensitivity, lower impedance level, and better selectivity.

Directivity of loops

Perhaps the most significant and valuable property of loop antennas is the fact that they can be used to determine the direction of an arriving signal. Let's look at how they can do that. Consider a loop and a vertically polarized passing electromagnetic wave as shown in Fig. 1-a. {**SORRY**!] A voltage will be induced in the vertical members of the loop, but none in the horizontal ones. If the voltages induced in each vertical member are the same (as they would be if the plane of the loop were perpendicular to the direction of travel, Z, as shown), then no current will flow. [editor's note: the advancing wave front hits the entire loop broadside, all at the same time, so there is no conductor cutting a magnetic line of force.] However, if the plane of the loop is parallel to the direction of travel of the oncoming wave, as shown if Fig. 1-b, then the wave will reach one side of the loop before the other, the total voltage around the loop will not be zero, and current will flow. [**transformer action**!] The voltage induced in the vertical members is proportional to the height of the loop, and voltage difference between the vertical members is proportional to the width of the loop. Therefore, the voltage around the entire loop is proportional to the product of its height and the width - that is, its area.

Another way of reaching the same conclusion is to say that the voltage induced around the loop is proportional to the rate of change of the magnetic-flux linkages through the loop. Then it is obvious that the area of the loop is the controlling factor, and the loop will receive the most signal when its plane is normal (perpendicular) to the magnetic field (H) of the oncoming wave (or in the same plane as the direction of travel of the oncoming wave).

Direction-finding shortcomings

The directional properties of loop antennas that we have just described permit you to null out interference or to obtain a broad peaking of a signal merely by rotating the loop. However, loops, though they are often used because of their relative simplicity, are not ideal direction-finding antennas.

Loops cannot distinguish between signals that arrive from opposite directions (for example, north and south). Another drawback is that trying to determine the source of a signal that arrives at an angle different from that of the ground wave (not exactly head-on) will usually result in an error. Ground waves themselves frequently arrive "tilted." That tilting is often due to the magnetic effects of such things as the steel I-beams of buildings (which distort the boundary conditions even for close-in ground wave reception). One way tht the problems caused by downcoming ("tilted") waves can be reduced is by using an *Adcock* antenna. We won't discuss that antenna in any detail except to say that it operates by canceling out voltages induced in its horizontal members. A third problem that loop antennas have in direction-finding applications, especially at low frequencies, is due to the *antenna effect*. The antenna effect is seen when a direction-finding antenna acts like a simple, non-directional one. Loop antennas, when used at low frequencies, are subject to that effect because their size is aonly a fraction of a wavelength, and they pick up interference from a signal derived from the electric, rather than the magnetic, field. A loop's symmetry should ideally cause that signal to be cancelled out, but in real

systems the effect is often the source of problems.

Resolving those problems

If you were to turn a loop antenna through 360 degrees and observe the strength of the signal received, you would obtain a reception pattern that looked like a figure-8. Such a pattern leaves you with a 180 degree uncertainty as to which direction the signal is from. That uncertainty can be resolved by using a whip antenna in conjunction with the loop to cancel one of lobes of the figure-8 pattern. That is done by coupling the output of the vertical antenna to the loop so that the voltage induced in the loop by the coupling is 90 degrees out of phase with the voltage the passing wave induces in the vertical antenna. Figure 2 [*in the magazine only]* shows the cardioid directional pattern that results from combining the figure-8 with the omnidirectional pattern from a whip. The sense of the incoming signal is usually determined by rotating the loop to cancel one of the lobes of the figure-8. In practical systems it is necessary to provide some phase- and amplitude-balancing between the two antennas.

To reduce the antenna effect that distorts the loop's directional pattern, and to obtain the best performance (in terms of detecting sharp nulls and uniform amplitude-peaks as the loop is rotated), the loop should be mounted within an *electrostatic shield*. That arrangement balances the loop by making sure that all parts of it will have the same capacitance to ground. That shield or cavity also protects the loop from the *induction field* created by nearby disturbances. The induction field refers to the electric and magnetic fields in the immediate vicinity of an antenna. Those fields decrease rapidly in strength with distance, and the induction field is usually ignored (and the *radiation field* is all that is considered). However, wires and other metal objects near the loop can take energy from a passing wave and produce induction (and radiation) fields that can induce spurious voltages in the loop.

A shield over a loop antenna (one type of shielded loop is shown in Fig. 3 [*but not here!*]) will not appreciably decrease the amount of magnetic flux that passes through (and links with) the loop when a wave goes by - as long as it does not form a complete (shorted to itself) turn. An insulated segment or gap is always left in the shield so that it does not become a shorted turn. Without the gap, the shield would form a shorted turn and it would reduce the magnetic field linking the loop so that no signal could be received by the internal wire(s). With the insulated segment or air gap, alternating currents can be induced in the metal shield (but no current will flow), and voltages will be induced in the internal wire(s). Some experimenters have wound loops inside slit *Hula-Hoops* and then shielded them by wrapping the outside with aluminum tape, leaving a gap in the tape at the top of the loop. Ferrite-core loops (which we will discuss shortly) are usually mounted axially in a trough or U-shaped channel (with the top and ends open to prevent a shorted turn) for electrostatic shielding.

A method for making a square box-frame loop is shown in Fig. 4 [*sorry again*]. A long length of U-channel is formed into a box frame by cutting slots into the side of the channel and then bending the material. [*The bottom of the U is toward the inside of the box. The slots are cut in the "upright" arms of the U.*] A small gap with a plastic insulator in it is left at the top of the frame; the insulator holds it together and prevents it from forming a shorted loop. The coil winding is supported on plastic foam, just

below the outer edges of the U-channel.

Winding loops

The distributed capacitance of the loop may, especially at low frequencies, cause the current to vary at different points on the loop and cause deviations in the directional pattern. A technique for reducing the distributed capacitance of the loop windings is to make the loop in a *mobius* form. A mobius loop is one where the coil is "twisted" so that (except at the start/finish point where the wires cross) all the "even-numbered" turns are adjacent to one another, with the same being true for the "odd-numbered" turns. The distributed capacitance of the mobius-type antenna shown in Fig. 5 is about one-half that of the antenna illustrated in Fig. 4 - even though both contain the same number of turns. The mobius-wound antenna also has a wider bandwidth.

Effective length

When we discussed active-antenna systems [*in a prior article in the series, and which I don't have*], we frequently mentioned the *effective length* of an antenna (often referred to as *effective height*). We can also talk about the effective vertical length of a loop antenna. An approximation for computing the effective length, *LL*, of loop antennas is

LL = (2*pi*n*A*Mu)/(wavelength) [Eq. 1]

Where wavelength is in meters; n = the number of turns in the loop; A = the cross-sectional area of one turn in square meters; Mu = the effective permeability of the core material (= 1 for air core); and wavelength = (3*(10**8))/(frequency in Hz). [*That's wavelength = three times ten to the eighth power, then divided by frequency*.]

Small-size ferrite-core loop antennas

It is often useful to consider the smallest practical size of loop antenna that can be used, say for reception of signals such as those from WWVB at 60 kHz. Using a ferrite core increases the effective permeability of the core and, as you can see from equation 1, that increases the effective length. Ferrite cores are available commercially in several different permeability ranges. Figure 6 is a chart that illustrates the effective permeability of a ferrite rod compared to the bulk permeability of the ferrite material.

The whole idea of using a ferrite-rod core is to increase the magnetic flux density through the loop. For the maximum effect, you want to have as much of the core exposed to the winding as possible. Compact, multiple-layer coils in the center of a long core-rod are never as sensitive as a single-layer coil that covers almost the whole length of the rod. Unfortunately a long coil has a problem in that the distributed capacitance of the coil winding is quite high, and the Q of the long coil will not be as good as a coil with a better "shape factor" (smaller length-to-diameter ratio). To maximize the coil's sensitivity to the magnetic field in space, the product of the number of turns and effective permeability of the rod should

be as large a number as possible. From Fig. 6 it can be seen that the whole length of the rod should be used to maximize the effective permeability. Another factor to consider is the effect that the ferrite material used has on the Q of the coil. (At low frequencies, the maximum Q that can be obtained depends on the core material, its size, and the signal frequency.) Figure 7 describes the effect on Q for an 800 Mu bulk-ferrite-material rod that measures 1/2 x 7 x 1/2 inches. It also describes the antenna's response with and without external capacitances added. The winding properties of the ferrite-core loop are included in Table 1, and Fig. 8 shows the ferrite-core loop-antenna itself.

Comparing loops

The comparative properties of a ferrite-rod antenna and the two air core box frame loops (shown in Figs. 4 and 5) are shown in Table 1. The scramble-wound box loop, which is in a slightly smaller U-channel, has a higher winding capacitance that results in a resonant frequency of 180 kHz. The mobius flat-wound loop has only half the winding capacitance and almost the same inductance. That results in a higher resonant frequency of 275 kHz. Both of the air-core box loops are intended to be operated in the wideband mode with no external tuning-capacitance. *[editor's note: this is the only place I've seen this "no tuning capacitor wideband mode" mentioned.*] The mobius box-frame loop has exceptionally deep nulls of 40 dB or more in the 60-kHz to 100-kHz frequency range. The ferrite-rod loop is intended for fixed-frequency use (tuned to 60 kHz with an external tuning capacitor) for WWVB reception. Similar ferrite loops (where the loop coil and housing is different for each frequency band) that cover a wider frequency range are available commercially from several sources.

For an untuned box-loop, the upper-frequency limit is determined by the self-resonant frequency of the coil and its distributed capacitance. The effective length is greatest at that point, and it decreases by a factor of 10 or so at the 10-kHz low-frequency end. The box loop can also be tuned by placing a tuning capacitor in parallel with the loop coil. That will increase the Q, but a preamplifier with a higher input impedance will be required. The best power transfer from the loop coil to the preamplifier is usually obtained when the loop impedance and the preamplifier input impedance are in the same range - which is not at highest Q. In designing loop antennas there is always a compromise to make between selectivity and sensitivity. An untuned loop with a rather broad self-resonant frequency peak (which is the case for the flat mobius-coil box-loop) provides the best sensitivity and also the deepest nulls of the antennas compared in Table 1.

Balanced Loops

As we discussed previously, to obtain the best null performance, loop antennas should be operated so that the capacitance between the antenna and electrostatic shield is the same at all points along the loop. With a single winding that's a problem, since one end of the winding has to be grounded in some way. A loop with a center-tapped winding is often used together with a preamp with a balanced input, but there is a better way of winding loops on long ferrite rods that also reduces the inductance of the whole winding and results in a single-ended termination for the loop.

The technique developed by the U.S. Army Signal Corps many years ago, involves making right-hand and left-hand-sense windings starting at the center of core. The resulting loop, shown in Fig. 9*, still has opposite-phase nulls off opposite ends, but now has excellent electrostatic symmetry with respect to the trough shield. (The ferrite core loop discussed earlier was a balanced loop.) The sensitivity of this coil is about the same as that of a coil wound in a single direction from one end to the other, but the inductance is reduced, resulting in a higher self-resonant frequency. The termination point in the center of the core practically eliminates induction-field noise pickup, even with a single-ended preamplifier system. When winding a coil with a relatively large number of turns, it is advisable to check the winding for inductive balance because the ferrite core material may not be uniform from end to end. Another factor contributing to non-uniformity is that it is difficult to wind a perfectly spaced coil by hand. That is why the figures indicating the number of turns on each side of the antenna described in Table 1 are different.

To tune the balanced loop coil arrangement shown in Fig. 9* to resonance at 60 kHz, a fixed capacitor of about 500 pF can be placed in parallel with a small variable capacitor of up to 350 pF (and the 330 pF distributed capacitance of the coils). That allows the total capacitance to be set to about 1000 pF - the capacitance required for resonance with the 6.89 mH inductance indicated in Fig. 7.

Balun method

Another technique for making the capacitance of a single-winding loop symmetric with respect to the electrostatic shielding is to employ a toroidal balun (BALanced-line to UNbalanced line) transformer between the loop winding and the preamplifier. That technique is illustrated in Fig. 10. The balun is used with the air core box loops shown in Fig. 4, which have no center tap on the loop windings. The trifilar-wound transformer consists of about 30 turns of No. 30 insulated wire-wrap wire twisted 6 to 8 turns-per-inch and wound on an Amidon (12033 Otsego St., North Hollywood, CA 91607 [*www.amidon.com I think*] FT82-75 high-permeability ferrite core. That makes the loop coil, which is a balanced source, look like an unbalanced source to the preamplifier. Baluns can also be used with ferrite core antennas wound in a single direction (instead of the right-left method of Fig. 9).

Loop antenna locations

Loop antennas are much less sensitive than small whips, but they have the advantage of having more selectivity as well as having directional null- and peaking- properties. It's a good idea to place a loop in the attic of a house well away from the electrical appliances and power lines, and to keep it away from major steel structural members (which distort the local magnetic field).

High-gain preamplifier

When designing an active whip antenna, we considered the whip to be a voltage source with a high internal impedance requiring current amplification, and (to reduce attenuation due to a mismatch) we wanted the preamplifier also to have a high input impedance. However, with a loop antenna, which is considered to be a low-impedance current source, we want a low impedance voltage amplifier.

Almost all LF loop antennas will require a preamplifier with a voltage gain on the order of +30 dB. Low-noise performance is more important here than with whip antenna preamps because of the lower signal levels at the loop terminals. There is a great varietyu of circits possible, but one of the simplest uses a power-FET or VMOS-FET like the one shown in Fig. 11. That preamp should be mounted directly at the terminals of the loop in a weatherproof shielded box or inside of a trough shield (with the balun transformer, if required). The output of the amplifer is fed (through a coaxial cable) back to the same receiver coupler that we used with the active antennas described in previous articles. The gate bias voltage divider trimmer potentiometer is adjusted so that the operating current of the receiver coupler is about 40 mA. The VMOS transistor used can be the Siliconix VN10KM. You can also use an ITT BS170 - which has properties similar to those of the VN10KM, but a different pinout. The series resistor for the gate bias, about 15,000 ohms, is chosen to approximately equal the reactance of the loop coil at the highest or cutoff operating frequency. If a tuned loop coil with higher Q is used, then the value of the resistor should be increased in value to 100,000 ohms or so. The output transformer can be the primary winding (about 200 or 600 ohms) of a subminiature or ultraminiature audio transformer. The secondary can be left open for operation up to the 500 kHz region. At higher frequencies a bifilar toroid - such as the one wound on an Amidon FT50-75 core for the wideband active whip preamplifier - can be used as an output transformer. The preamplifier will have a voltage gain of about 30 dB when driving a 50 ohm load at the receiver coupler.

Bench testing loops

You can evaluate the resonant frequency of a small loop antenna system by connecting a coupling coil and a 50 ohm load resistor in parallel as a termination at the end of a coaxial cable from a signal generator. For low frequency testing (below 500 kHz) the coil can be a 1-mH pi-wound RF choke. The probe is brought very close to the loop under test to inject a small amount of signal by magnetic or inductive coupling. The output from the loop and/or a suitable preamplifier are then observed (either on an oscilloscope or a receiver) as the signal generator is tuned over the desired frequency range. The coupling sensitivity of both the probe coil and the loop will decrease at lower frequencies. This simple magnetic probe will allow you to obtain a good idea of the loop resonance and its general performance. You can also estimate the loop inductance by placing known capacitors in parallel with the antenna and then observing the response. The coil's distributed capacitance can be estimated by computing the difference between the resonant frequencies of the loop with and without the added tuning capacitance.

***** *for Fig. 9, take the piece of wire to wind the loop with and fold it in half. Lay the wire on a table in a long, narrow V layout. Set the rod core on top of the wire close to the apex of the V and put a dab of glue there to hold it. Then roll the rod along the wire so that the wire winds up around the rod and expands the coil toward both ends at the same time. That's the bidirectional coil shown in* Fig. 9.

[Note: I hope that MS Word's spell checker caught all of my multitudinous typing errors! If not, SORRY!]

------home ---------- updated October 12, 1999 & December 16, 2001

AN EASY VLF LOOP

200Hz-20kHz reception without transformers

by Renato Romero and Marco Bruno

A warm afternoon, in a summer day of this year, I was yellow painting an old hula-hop. My wife looked at me, saying "What are you doing?". "I'm yellow painting a hoola-hop" I answered. My wife replied: "I see, but why are you painting ... oh my God! Another antenna!"
"Yes, but this antenna is different from the other ones". And she, laughing: "I see, it is yellow(*)". I explained: "With this kind of antenna I can receive signals that are not received with the others one". And she: "It does mean you will put all the other antennas away?" "Not exactly ..." I answered.
But my wife is right: there are antennas at every corner in my garden. Well, this antenna will not solve your family problems, but it can give some advantages in VLF reception, in comparison to the Electric field receivers like RS4; especially when the noise conditions are not very good, like in the city or near the house. The preamplifier of this antenna is very easy to build.

(*) we have a new theory, on antenna colour affecting radio performance, expecially in foggy environments ;-)

WHY ANOTHER LOOP PROJECT

The original small loop project started some year ago, in 1995. The electric circuit is reported in "RECEPTION TECHNIQUES / Active an passive system" on this web site. It was a good project and a copy of this receiver has been used also by the "Astronomical Association of Umbria" to study the correlation between VLF and Meteor events. But its construction can give some problems: the loop antenna is easy to build but the preamplifier has a lot of active components (many gain stages, much noise). Some people asked me how to find the input transformer: I used an old impedance transformer, taken by an old Phonola tube radio; but where to buy other similar components?
Dave Ewer helped me with his loop amplifier project, as descripted in "RECEPTION TECHNIQUES / Mobile stereo NATURAL RADIO 2". His project, based on mine, gives better results in term of S/N ratio. Dave in his project uses only standard components, like a Mauser device as transformer.
The project here presented was based on ideas by Marco IK1ODO, and doesn't uses any transformer. The loop is connected to the preamplifier circuit directly and the circuit contains only one active component.

The signal output can be connected directly to the LINE input of the Sound Blaster card, or LINE input of a tape recorder.

THE LOOP PROJECT

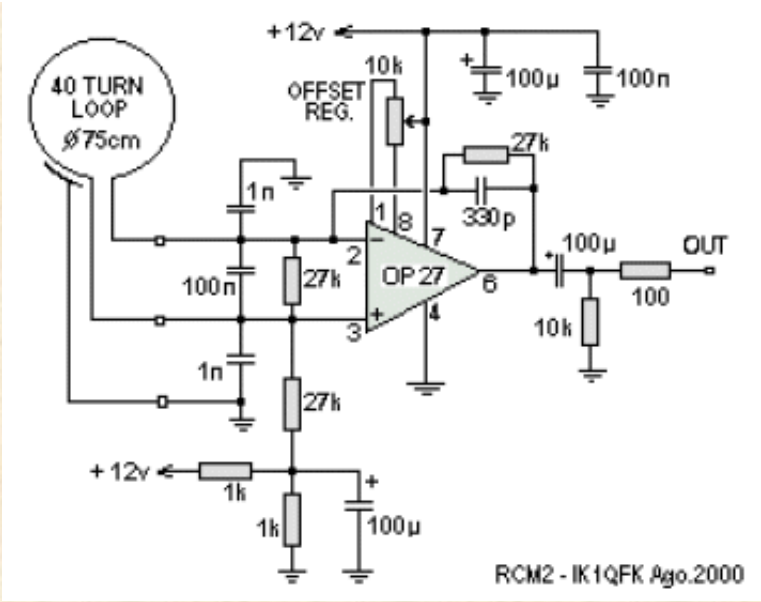
The choice of loop dimensions must take two factors in account: to have an antenna big enough to be sensitive and small enough to be transported or installed on a balcony without disturbing too much the view.The choice of the support fell again on a plastic hula hop because of the economy in materials, conserving a clean look. Dimensions and turns number have been calculated with Rjeloop3.exe by G4FGQ.

L Length of one side of square frame, mm 660
N Number of turns of wire on the frame 40
D Diameter of wire, milli-metres 0.6
R Ratio of (winding pitch)/(wire diameter) .. 1.05
F Frequency, kilo-hertz 2
M(essages) toggles this window on & off only when it can be seen on bottom line.
Inductance ..... 3181.2 micro-henrys
Inductive reactance ..... 40 ohms
HF loss resistance of wire . 7.44 ohms
Radiation loss resistance .. 0.00 milli-ohms
Self-resonant frequency .... 0.6 mega-hertz, approximately
Total capacitance required . 1990594 pico-farads for resonance
deduct stray capacitance 20 .. ..
Setting of tuning capacitor. 1990574 .. ..
Approximate coil Q 5
Receiving sensitivity ..... 146 decibels below 1/4-wave vertical
Width of winding ..... 25.2 milli-metres
Total length of wire ..... 105.60 metres
Impedance seen across loop . 0.2 K-ohms, when tuned to resonance
Impedance seen by Receiver . 0.0 K-ohms, via 1-turn coupling loop
L,N,D,R or F to change value, C(lear), B(ack), M(essages) or Q(uit) ..

The program works assuming a square loop, while the hula hop is round, so a square has been calculated with the same area, resulting in a side of about 66 cm.The loop has 40 turns of copper wire of 0.6 mm2 section for a total of 106 m and a resulting inductance value of 3.2 mH.
Mechanical details are not given here since we are talking about a simple shielded coil in air. The hula-hop tube was cut on the outer rim to allow the insertion of the wire, one turn at a time. The shield is made from aluminum foil wrapped around the whole loop, except for 10 cm in its superior part where the shield is interrupted. Everything was covered with adhesive PVC tape to protect from bad weather and painted with a protective enamel. The shield is not indispensable (see later), during all trials I haven't seen any difference between the antenna with shield and without it. The final result is shown in picture and is esthetically very similar to to the RCM preceding model.

THE CIRCUIT

The circuit uses a low-noise and stable op-amp, the well known OP27.



EASYLOOP, Electric scheme

Compared with other common devices like the TL081 or µA741, this opamp has interesting characteristics. The intrinsic noise voltage is very low at 3nV/sqr(Hz), to be compared with 18nV/sqr(Hz) for the quiet TL081 or 90nV/sqr(Hz) for the µA741! To improve this value you need special and sophisticated circuits. The input noise current is also very low, so you may use it on very low impedances like loops. An impedance step-up transformer is simply not needed.
The circuit is simple, being derived from the configuration used with low-impedance dynamic microphones. There is an important difference between this circuit and other seen previously: the loop is terminated in a zero impedance (the virtual ground at the input of the op-amp). So, the useful signal is the current developed in the loop; other designs use the voltage developed on the loop, wich is terminated on a high impedance. Using a low-Z amplifier allows operation to low frequency using small loops, and the sensitivity is very good.
The overall DC voltage gain is determined by the ratio between the 27k negative feedback resistor (pins 2-6) and the DC resistance of the loop (few ohm). It has to be determined experimentally if you decide to alter the number of turns, or the size of wire, to achieve DC stability and sufficient gain.
Input capacitors and the 330pF one limit the frequency response of this loop to about 22 kHz, and stop MF and HF interferences.
The 27k resistor between pins 2 and 3 acts only in case of disconnection of the loop; it may be omitted. The 10k resistor at the output limits "pops" when connecting the output of the preamplifier to the SB input; it could also be omitted.
The circuit is powered by a single supply between 12 and 24V, and requires a single adjustment for the offset voltage. With the loop connected to the preamplifier apply power and turn the 10k potentiometer (ideally, a 10-turn device) to have exactly half the power supply voltage between pin 6 and ground. Allow some minutes for thermal stabilization of the IC.
The OP27 is not a consumer product, but is available from distribution chains like RS or Distrelec in Europe, Jameco or Radio Shack in the USA. The price is about $2.
Beeing the whole loop a low impedance device closed into a short circuit, and taking in account the common mode rejection ratio of the op-amp, the shielding is not necessary. A good shield, with a low impedance path against ground, and a metallic box for the preamplifier will contribute to the long life of the IC. In any case install it on a socket, and buy more than one... we purposedly included no protections for the IC in this project.

SOME MEASUREMENTS

Some measurements on the circuit in my implementation:

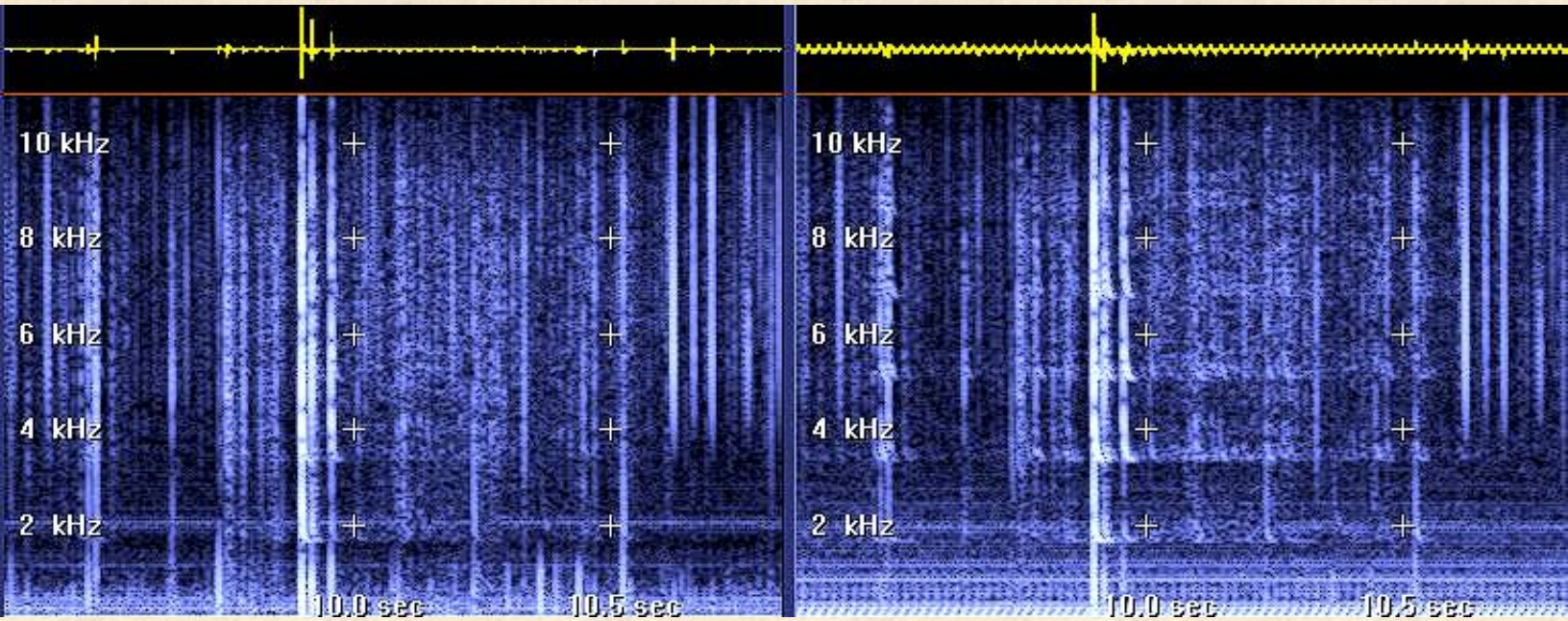
FREQUENCY (Hz)	LOOP IMPEDANCE (Ohm)	GAIN (Vo/Vi)	GAIN dB
16	0,3	168947	105
30	0,6	90105	99
60	1,2	45053	93
125	2,5	21625	87
250	5,0	10813	81
500	10,0	5406	75
1000	20,0	2703	69
2000	40,0	1352	63
4000	79,9	676	57
8000	159,8	338	51
16000	319,6	169	45

The voltage gain decreases with F, compensating the increasing loop sensitivity. The output signal is constant respect to F, and is only funtion of the H vector flow thru the loop. More later ... see section 2 (to be published) for a more theoretical treatment of the loop frequency response.

In our case, the DC loop resistance is about 8 Ohm. The loop has an impedance of 8+j8 Ohm at 300 Hz; this is the low frequency corner of the system. Under this frequency the loop resistance prevails over the reactance, and we have a 6dB/octave rolloff in the output signal.
Increasing the wire section allows going to lower cutoff frequencies; the limit is the input noise of the OP27. In section 2 we will demonstrate that the low frequency corner is only determined by the WEIGHT of the copper used, and not by the number of turns! (please don't start buying shares of copper mines ... I already bought everything with the VLF community in mind).

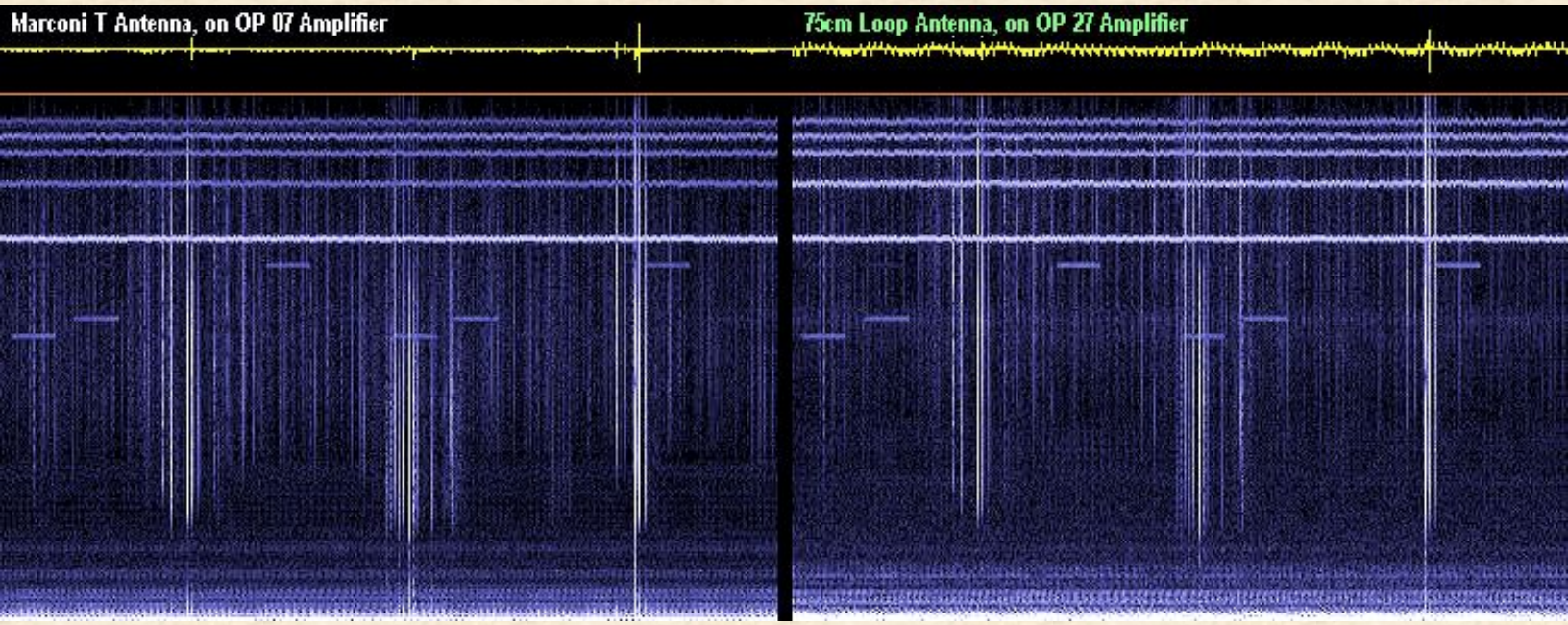
THE RESULTS

The quality of a design should be evaluated looking at the results. The EASYLOOP is compared here with a large Marconi "tee" antenna, giving the best results in VLF/ELF in my installation. In the following spectrogram statics, line harmonics and tweeks are visible. The E field antenna has more statics, and the loop is less sensitive under 1.5 kHz. Tweeks are stronger and cleaner with the loop; anyway, the results are very similar, but the area occupied by the loop is about 500 times smaller.



The same signal, received by Marconi T antenna (11m high with 45m top) compared with the easyloop.

The following spectrogram covers the full 22 kHz band allowed by the SoundBlaster. Here also the results are very similar, and the RTTY signal around 18-20 khz are loud and clear. The russian Alpha signals are even cleaner, with less statics.



The loop was oriented for best power line noise rejection, and positioned at the base of the Marconi vertical antenna, to have similar noise conditions.

CONCLUSIONS

A simple, but in our opinion innovative, small loop antenna for VLF/ELF has been described. The design is open to experiments and improvements, and your suggestions are welcome.
"Nihil sub sole novi" (nothing new under the sun, say the Latins), but the simplicity of this design in relation to results makes this project an interesting one. In urban noisy areas you may turn the loop to minimize interference, and this resource is very useful. The great simplicity of the preamplifier circuit, built without hard-to-find transformers, is ideal for home building.
The loop is a low impedance device, is floating respect to ground, and may be powered via long wires without compromising the performance.

(© Horrible English translation and circuit theory by Marco IK1ODO; building and experimentation by Renato IK1QFK)

Return to the main Index

AMANDX PRESENTS

AN UNAMPLIFIED THREE OR FOUR FOOT BOX LOOP

Below you will find plans to build a three or four foot box loop for the AM broadcast band. The
loop will tune from 530 to 1710 kHz covering the whole band including the new expanded band .
This loop design was first produced by Don Moman back in the early 1980's and has proven to be
a good solid design. The main advantage of this loop's design is that it uses almost no metal. This
allows the loop to keep its pattern and increases the loop's ability to null stations.

The loop is Based on Don Moman's famous loop his drawing is at the bottom of the page.

The instructions below are for a four foot loop. If you do not have room for such a large loop all
you have to change is:

The two cross arms should be 33.5 inches in length not 45.5 inches.

I have included drawings as well as pictures of my four foot loop at the end of the article.
These should help you visualize the loop as you build it.

PARTS:

1- Variable capacitor of 0-365 pf, You can often find these in old AM radios that can be found at
flea markets or garage sales or on eBay at www.ebay.com. or KW TUBES at
http://kwtubes.s5.com/ or at Midnight Science at http://www.midnightscience.com/

1- Knob for the tuning capacitor. You can use a vernier knob for finer tuning.

175 feet of wire.. 20 gauge coated/insulated works well. The wire can be solid or stranded.

4- Pieces of 2 x 2 cedar cut 7 inches long These will be the end pieces.

2- Pieces of 2 x 2 cedar 45.5 inches long (33.5 inches for the 3 foot loop). These will be the cross arms.

2- Pieces of 1 x 2 cedar 6 inches long. These will be the braces to tilt the loop.

1- 1.5 inch diameter wood dowel 36 to 40 inches long. This will be the mast.

1- Piece of 2 x 1 cedar 6 inches long. This will allow you to mount the tuning capacitor

1- Piece of 2 x 2 cedar 4 inches long. This will be a brace support.

1- Outdoor plastic umbrella stand and a piece of PVC pipe to fit the mast into it. The stand should be filled with sand to give it weight to balance the antenna. The pipe should be about 12-15 inches long. You may substitute another stand but try to insure it has as little metal as possible. To much metal will distort or decrease your nulls.

1- Wire connector to connect the wires.

2- Bolts with nuts 3.5 inches long

4- Wood screws 1.5 to 2 inches long

1- Length of coax to feed antenna to the radio. Keep as short as you can but remember that the loop must still be able to tilt and rotate.

PREPARATION OF THE PARTS.
I used 2 x 2 and 2 x 1 cedar to build the loop but you may wish to substitute the type of wood with another variety. Just make sure it is a strong wood with few knots.

CROSS ARMS
To form the cross arms find the center of the 45.5 inch pieces of 2 x 2. Measure 3/4 of an inch on
either side of center. Shade this area in. Cut out the shaded area as shown in Figure C. Cut out the
shaded area to a depth of 3/4 of an inch. This will form a notch on each arm that will allow you to
fit the arms together to form an X.

END PIECES
Take each of the 7 inch long pieces of 2 x 2 and line them upside by side.. Mark off a line across
all of the pieces every half an inch. This should give you 13 lines spaced one half an inch apart
across all four end pieces. You then will have to cut a grove about 1/4 of an inch deep in each
line. This will give you 13 grooves on each end piece as shown in Figure A.
Once that is done turn all the pieces over to the other side that has not been grooved. You will
have to make a notch cut similar to the one cut on the cross arms. Find the center of each end
piece and again measure 3/4 of an inch from center. Shade in this area as shown in figure B. Cut
out a notch in the shaded area to a depth of about 1/4 of an inch deep. This will form a notch that
will fit to the ends of the cross arms. You must do this to all four end pieces and try to be as
accurate as possible to insure a balanced fit.

BRACES
To form the braces as shown in Figure E drill two holes on the flat side of the 6 inch 2 x 1
wooden pieces. Each hole should be centered one inch from the end of the wooden piece. The
size of the hole should allow the bolts you are using to slide through as tight as possible.

DOWEL STAND
Figure F shows the 36 to 45 inch long 1.5 inch diameter dowel and the 4 inch long piece of 2 x 2
assembled. To make these two pieces fit you must cut a notch into the dowel. Cut a 4

inch long «
inch deep notch out of the end of the dowel. The 4 inch long 2 x 2 will sit on this notch to form a
support for the cross arms. Drill a hole centered about 1 to 1.5 inches from the top of the 2 x 2
piece. The hole should match the bolt you are using.

ASSEMBLY

DOWEL STAND
As shown in Figure F Take the 4 inch long 2 x 2 piece and fit it into the notch on the dowel with
the hole on top. Once you are sure of a good fit glue the two pieces together with a good wood
glue. You could use a screw but it is not necessary. This dowel stand will now fit into the
umbrella stand and should rotate easily.

TUNING BOARD
Take the 6 inch long piece of 1 x 2 as shown in Figure D and mount your wire connector 1 to 2
inches from the end of the board. On the under side of the board mount the tuning capacitor at the
opposite end of the board. Keep the capacitor close to the front of the board with enough
clearance to attach the knob. You can use a glue or double sided tape to mount the capacitor.

END PIECES
Attach each of the four end pieces to the ends of the cross arms. First of all fit the cross arms
together to form an X shape. You can use some wood glue to keep them together. You can
attach each end piece using glue and you can put a 1 to 1.5 inch long wood screw into the center
of each piece so it will be secured to the end of the arm. This is shown in Figure D.

MOUNTING THE TUNING BOARD
As shown in Figures G and D mount the tuning board on the top side of any of the end pieces.
The Top will be the side with no grooves on it. This will now be the bottom of the

loop as shown
in Figure G.

MOUNTING THE BRACES
Take one of the bolts and put it through one brace as in Figure E then through the piece of 2 x 2
attached to the dowel as shown in Figure F and finally through the second brace. Secure the bolt
using the nut (I used a wing nut to make it easier). You now have a stand with a rotating and
tilting mechanism. This can be placed into the umbrella stand as in Figure G.

MOUNTING THE LOOP
Slide the loop between the two braces and see where it would balance for tilting and rotating with
out hitting anything such as lights in the ceiling. I drilled a hole 17 inches from the center of the
loop on the bottom arm with the tuning unit attached to it. You can slide the second bolt through
a brace then through the hole in the cross arm and then through the second brace. Secure the loop
bolt with a nut as you had done with the first bolt as shown in Figure G.

PICK UP LOOP
In order to install a pick loop of wire into the assembled loop you must drill a hole 3.5 inches
from the tip of the loop arm in each arm. The hole need only be big enough to feed you wire
through. The pick up loop of wire is now wound the inside of the loop. You will have to drill one
more hole on the bottom arm about 1 inch above the first hole. Attach one end of the wire to the
wire connector and then string the wire through the holes around the loop until you reach bottom
again. Keep the wire fairly tight so there is little or no slack on the winding. Wind the end of the
wire through the second hole on the bottom arm and attach this end to a separate section of your
wire connector. The two ends must remain separate and not attached.

ATTACHING THE COAX FEED LINE

To attach the coax feed line to your loop strip off some of the covering to expose some of the center conductor and some of the braid. Attach the center of the coax to one side of the connector and the braid to the other side of the connector which the pick up loop is attached to. Check these connections to insure that they are tight and that they are isolated from each other. If you want you can try placing a capacitor in line with the center feed of the coax. I used a 680 pf capacitor to help match the loop and the coax . Do not attach this to the braid of the coax.

WINDING THE MAIN COIL

To wind the main coil of the loop Solder the end of you wire to the solder lug on the variable capacitor . Then proceed to wind the wire around the loop pushing the wire into the groves on the end pieces of the arms. After you have completed winding the wire around the loop attach the end of the wire to the from of the capacitor with some solder. The winding such be kept a tight as possible as you did on the pick up loop. You are now ready to tune the loop.

TUNING THE LOOP

The first step is to attach the coax feed line to your receiver. Tune the radio to around 1000 kHz. Tune the capacitor to peak the signal even if it is just static. Now go up and down the band peaking the capacitor to see what the loop's true range is. You will have to re-tune the capacitor about every 50 to 100 kHz. You will probably find that you can not tune the top of the band (1710 kHz). If this is the case then take one winding off of the loop by unsoldering the wire attached to the frame of the capacitor and unwinding once around the loop. Cut the wire and reattach the new end to the frame. Re-tune the loop and see what its new range is. With the plates meshed in you should be able to tune to about 525 kHz and with them fully out to

about 1710 kHz. You may have to take off 1 or 2 or even 3 windings to tune the loop to insure it
covers all the frequencies. If you take off more than one winding make sure that you end up with
a balanced number of open grooves on each end of the end pieces.

COMPLETED
Once you have this all set up the loop is ready to use and the DX will flow in. You will have to
experiment with tilting and rotating the loop to get the best nulls possible. The main things to
remember are:
-Tune the capacitor to the frequency you are listening to for the best signal.
-Rotate the loop to get a null as deep as possible.
-Tilt the loop to increase the null.
-Experiment with tilting and rotating slowly to peak the nulls as best you can. You may find that
the nulls are very narrow and you have to be careful.
-The best nulls are a combination of tilt and rotation.
-Using a vernier tuning knob will allow you to fine tune for the best signal peaks.

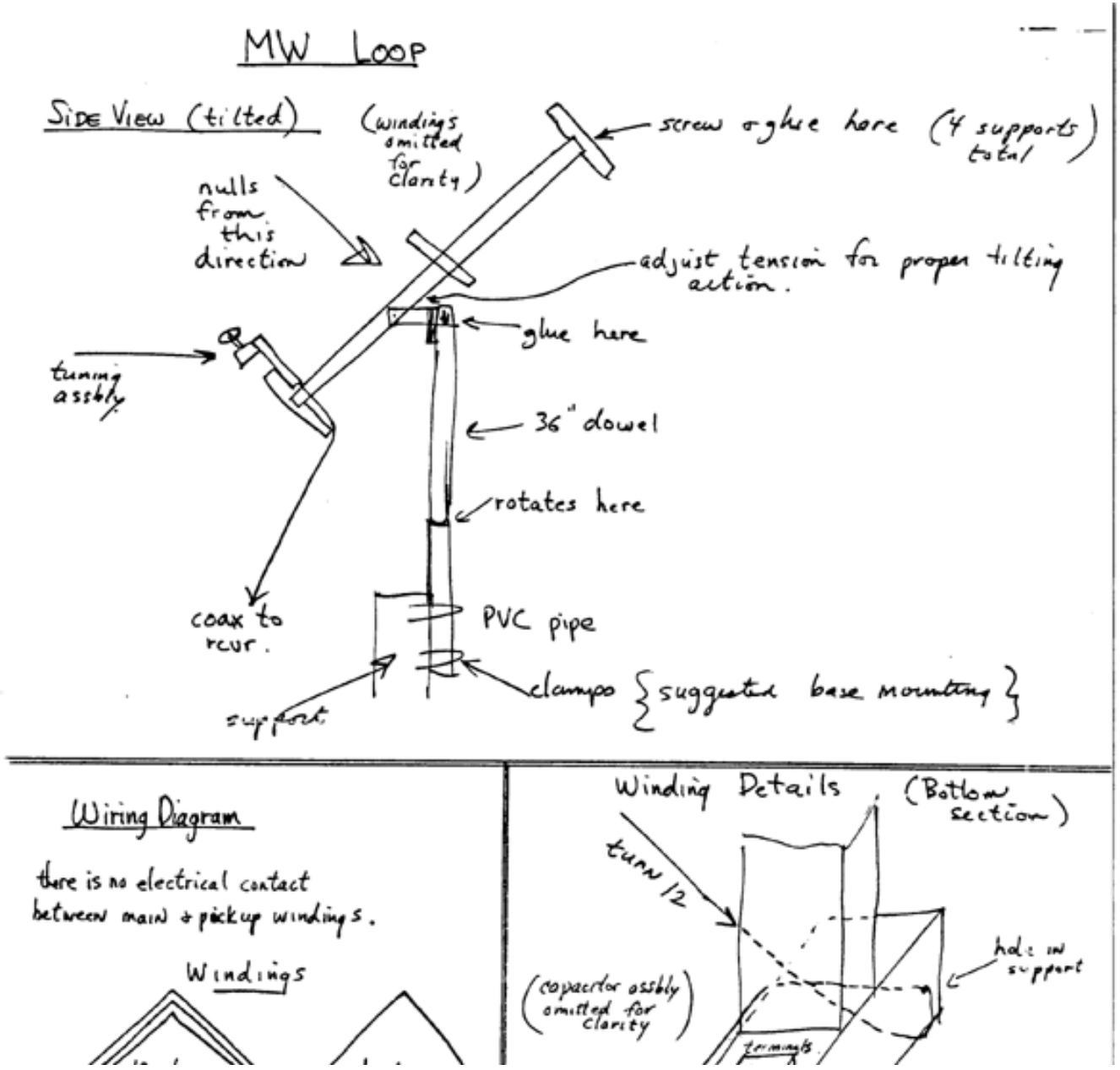
Please remember this is a guide and NOT written in stone. Feel free to experiment with the plans to
suit your needs and situation.

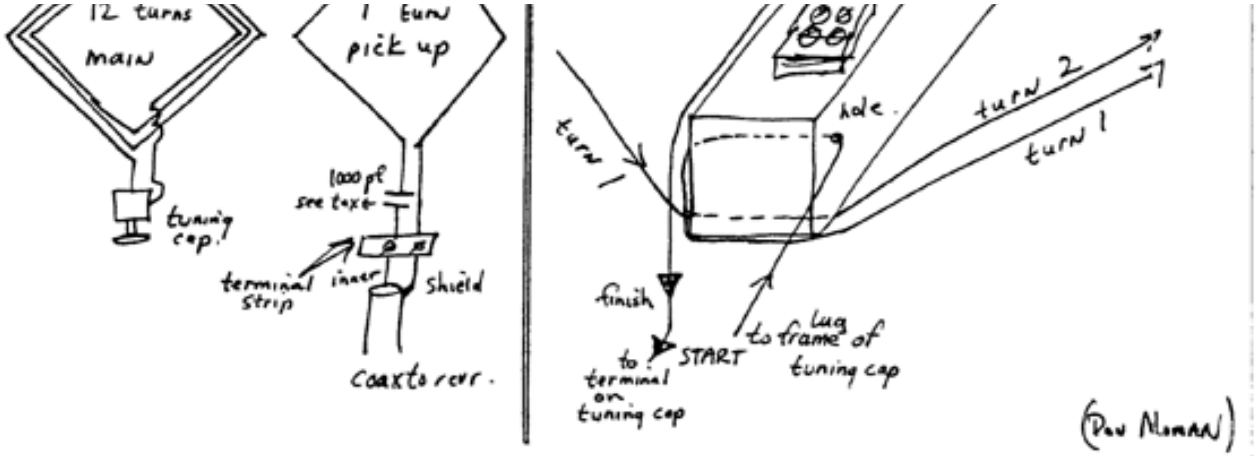
If you have any questions please write me care of saxelrod@mb.sympatico.ca

Link to further loop information.

- Antennas for MW by Don Moman
- Loop Antennas On the HCDX site
- DXers Tool Box Has a construction article.
- Minnesota DX ClubLoop Information
- 1 Meter Loop From Radio Australia.
- A Remotely Tuned MW Loop Construction Article.
- Joe Carr's Tech Notes Has articles on antennas.
- Vans Think Tank Contains a good list of antenna links.
- The Electronics Hobby Page Another site with a excellent listing of antenna and DXing links.

- The Electronic Hobby Page Has an extensive list of loop and radio information.
- Loop Discussion Has postings from various USNET groups.
- Small Transmitting Loop for the HF band also has links to other loop sites.
- Belar LP-1 and LP-1A AM shielded loop antenna




12 turns
main
1 turn
pick up
1000 pf
see text
tuning cap.
terminal strip
inner
shield
coax to rcvr.
turn 1
hole
turn 2
turn 1
finish
to terminal on tuning cap
START
to lug frame of tuning cap
(Dan Noonan)

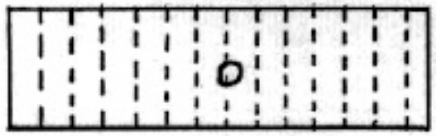


FIGURE A
End Piece Top View

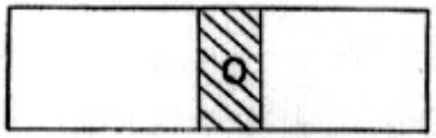
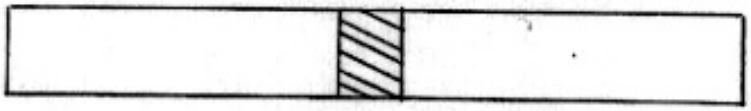


FIGURE B
End Piece Bottom View

Cross Arm Bottom View

FIGURE C



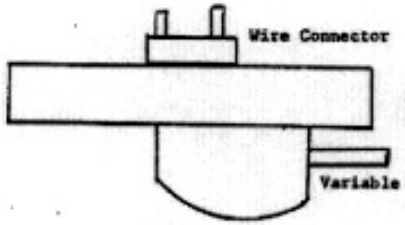


FIGURE D
Tuning Section Side View

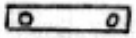


FIGURE E
Brace Side View

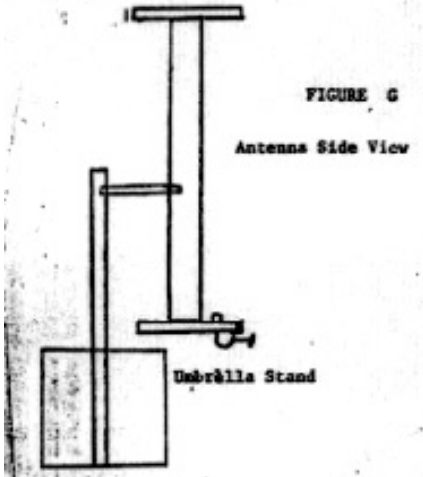


FIGURE G

Antenna Side View

FIGURE F

Dowel Side View

FIGURE F

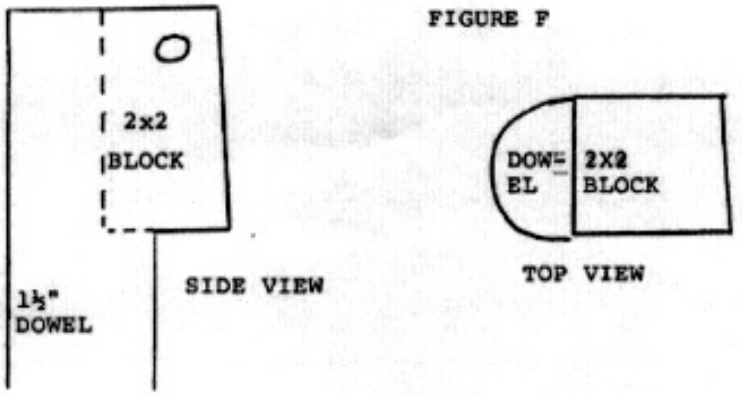
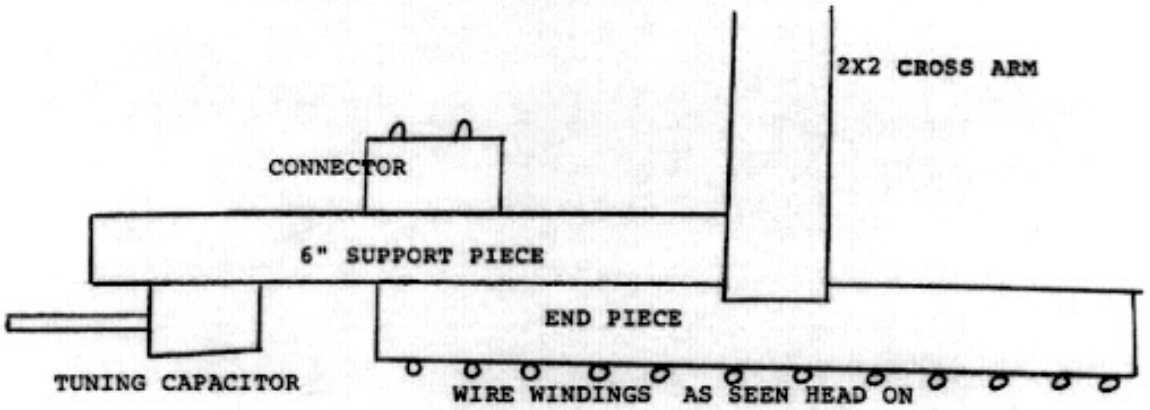
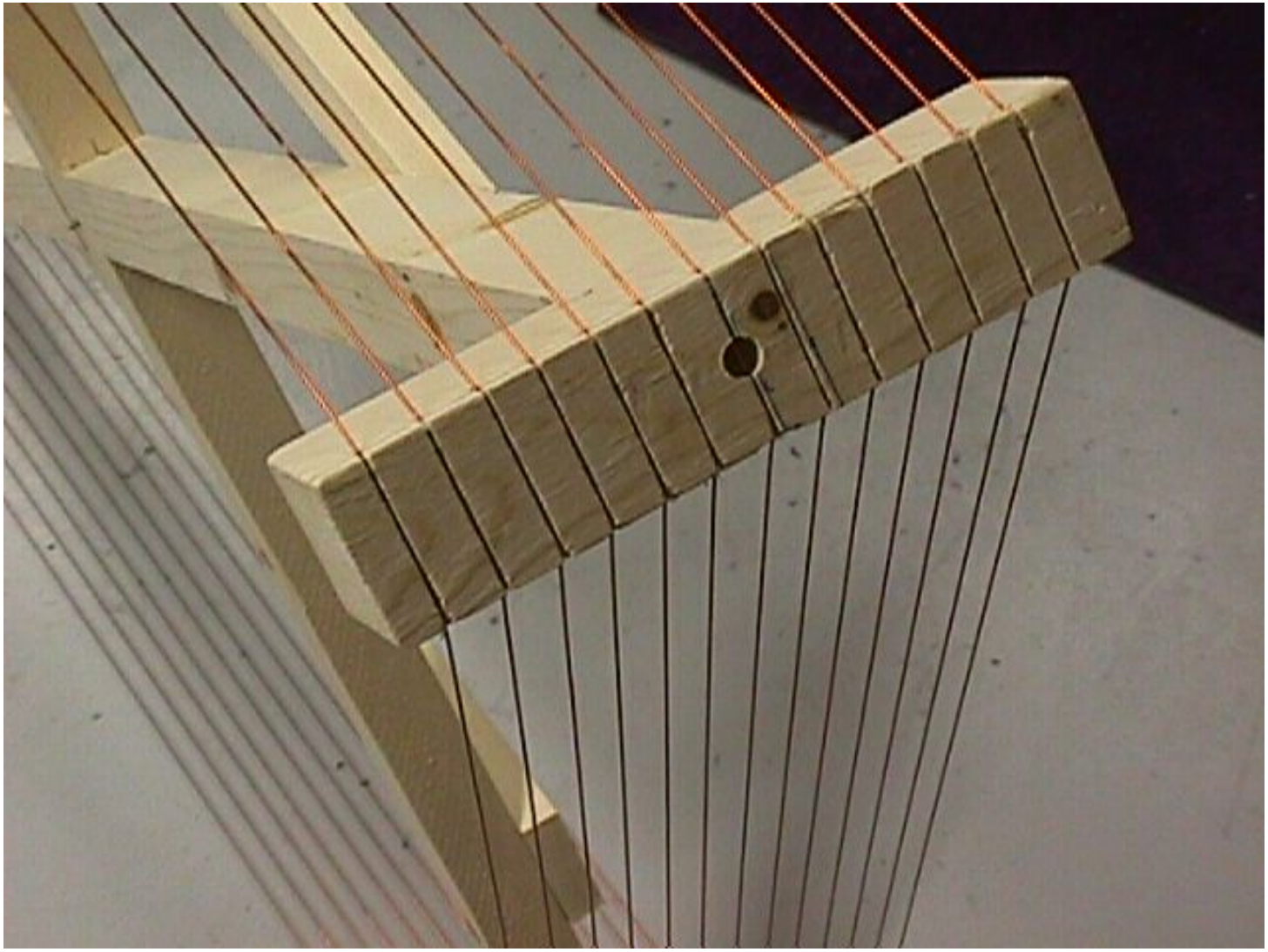
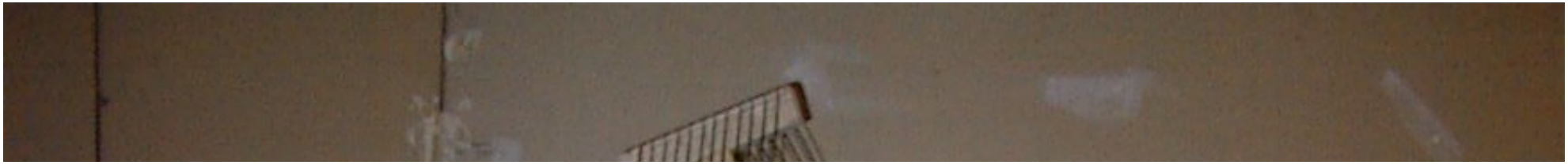


FIGURE D TUNING BOARD





Here is a pic of the loop Tom Doty built with some mods to the plans above. He used a microphone stand.



RETURN TO MAIN PAGE

Remember On A Clear Day You Can Hear Forever

AM/FM Reception Tips

Jump to:

- AM Reception
- FM Reception
- Sources for AM and FM Antennas

Also view our:

- CPR Network Map
- Statewide 2-Channel Details
- Program Descriptions and Schedule
- Listen online!

Colorado Public Radio transmits signals from AM and FM station and translator antennas across the state. All radio reception is affected by distance, physical obstacles and other broadcast signals. But often the handicaps imposed on radio signals can be lessened with relatively simple enhancements. Below are some general tips and a few examples of the kinds of antennas that may improve your reception. At the end we suggest some places to find a wide array of antennas to help you enjoy your radio more.

What Affects AM Reception

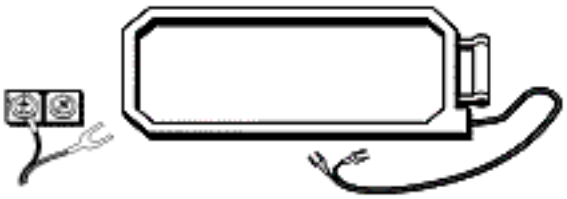
AM reception, which travels both on the ground and through the air, is prone to interference by a variety of sources: other radio stations, lightning storms, and nightfall, when an outlying AM station's signal can reflect off the ionosphere and skip over areas that receive the signal during the day.

How To Improve AM Reception

With their external antennas, **car radios** tend to receive AM radio best, but sound and signal quality varies from car to car. Cars that employ their rear window defrosters as antennas may receive AM signals better than those with traditional external antennas; some people can find improvement by replacing their factory-installed antenna with an aftermarket antenna of higher quality. Reception may be disturbed as a car moves from one location to another, passing in and out of areas where the signal is obstructed by power lines or tall buildings.

Portable and desktop radios also often work well with AM broadcasts. Many contain internal, ferrite loop antennas; sometimes the power cord is also the antenna. These antennas are relatively directional, meaning that the quality of the received signal

changes depending on where you put the radio. You may improve reception simply by moving your radio around until you are able to catch more of the signal. In some cases an external AM antenna may improve reception with a portable radio as it does with a component receiver.



When it comes to AM reception, not all **component AM/FM receivers** are created equal. Some have built-in antennas; some do not. Many high-end receivers, however, do have an external connection for an AM **loop antenna**, which might have come with the receiver when you purchased it. If your stereo receives AM poorly or not at all, you will need to install this loop antenna-usually a rectangular piece of plastic with two wires that connect to two screws on your receiver-and orient it appropriately for the best reception.

Better external loop antennas are also available. These are usually 8 to 12 inches in diameter and can be oriented and tuned just like you tune your radio to help eliminate nighttime interference and noise. Some must be hooked up directly to the external connections on your receiver; others need only be placed in close proximity to your receiver's existing AM antenna.

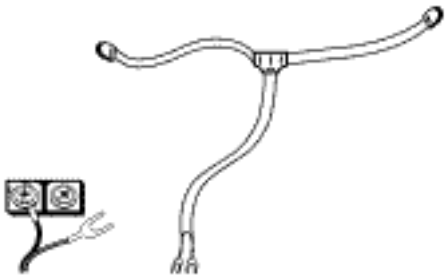
What Affects FM Reception

FM broadcasts deliver greater audio fidelity and are less susceptible to static, but they do have their own reception-related challenges. All radio waves travel in straight lines, and an unobstructed, line-of-sight path to a transmitting antenna makes for the best FM reception. Naturally, the farther the signal reaches, the weaker it gets, especially when out of line-of-sight. And when there are reflecting surfaces-tall buildings or mountains, for instance-near your receiving antenna, FM radio waves are also prone to a disturbance known as "multi-path." Like ripples in a small pool, these multiplied waves can cancel out the original broadcast signal at select points.

How To Improve FM reception

Because of multi-path reception, **car radios** are usually the worst receivers for FM. As your car moves, your antenna gathers signal reflections from multiple directions, wiping out the stereo portion of the signal and adding noise. One solution is to shorten the height of your antenna, reducing the sensitivity of your tuner so that it locks in on only the main broadcast signal.

Portable and desktop radios often have telescoping antennas or use the power cord or headphone cord as the antenna. When using one of these receivers, the position of the unit and the orientation of the antenna can be critical. If your receiver uses its power cord as an antenna, stretching out or moving the cord can improve reception. The same is true for units using the headphone cord as the radio antenna.



Most high-end **component AM/FM stereo receivers** require an external antenna, and many manufacturers supply the simplest kind: a T-shaped, flexible wire antenna called a **dipole antenna**. Attach this to the receiver's antenna terminals and orient the dipole as needed for best reception. If the dipole offers no appreciable improvement, you may need an external antenna. Designed specifically for FM reception, these look like TV antennas and are usually installed on a roof, on the sides of buildings or in an attic. Again, after connecting the antenna to your receiver, orient it until you get the best reception.

Sources for AM and FM Antennas

First, a word of caution: Make sure that any antenna you purchase is returnable if it does not give you the result you desire. That said, there are many sites both locally and on the Internet that offer antennas or the instructions necessary for building your own.

Radio Shack and similar electronics and hardware stores often stock antennas for both AM and FM reception. A good **AM loop antenna** sells for $10 to $50 depending on features and looks. FM antennas and combined AM/FM antennas are often available as well, for prices that can range from $20 to $200 depending on the features you want. Often it is best to call around first to find someone knowledgeable about radio antennas. And there are also many online resources, including:

Radio Shack:	www.radioshack.com
Terk Technologies:	www.terk.com
C. Crane Company:	www.ccrane.com
OneCall:	www.onecall.com

If you find a good source for information and products for improving reception, please let us know, either by calling 1-800-722-4449 or by contacting us online.

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Privacy Statement

|Antennas|AmDx|Clubs|Ham|Pirate|Rcvrs|UTE|Bookmarks|QSO|LogBook|

DX News, Tips, and Info

Recent DX News and Tips

- Special Shortwave Broadcasts during SWL Winterfest from Radio Europe and WBCQ. - via Cumbre DX

- Changes at BBC Ws North American Service
- BBC Ws Frequencies no longer used by the BBC to America
- BBC Ws Frequencies still being used to South America

- Vacation BCL Contest 2002
- OH8TA's DxPedition to Hailuto Island

- Standoff between US government and Kentucky State Militia Radio - from Cumbre DX Special

- "Media Network" Radio Netherlands' DX Radio Show Ended!!!
- Listen to NPR over AFRTS shortwave relays - in Upper Sideband!

- BUG in PGP - PGP Security - PGP ADK Security Advisory
- JITC Tadil/Link-11 ran Test Schedules.
- Enigma Machine Stolen from Bletchley Park

- The latest Cumbre DX Special Edition - from Cumbre DX
- Cumbre DX sends spare parts to Radio Gaalcaya! - You too can help!
- Glenn Hauser's World of Radio Page
- Glenn Hauser's DX Listening Digest
- Radio H.F. Internet Newsletter - By Sheldon Harvey

- When it's Hurricane Season! - - various links

- Check Out my friend DJ Stevie's RADIO 510 Webpage
- Listen in Real Audio to Radio 510's Special SWL Winter Fest Program. - from KIDD
- Information about the 14th Annual Winter SWL Festival - March 9 and 10, 2001
- Sights and Sounds from The 1998 12th Annual SWL WinterFest

Recent Information Posted on Various Listservers:

2m list

- **Re: [2M] Greenville SC repeaters**
  Sat, 2001 Nov 17 05:26:26 *Walt R Mitty <rgdong@juno.com>*

50Mhz list

- **[50MHz] VHF: 6m 8877 Amplifier Efficiency**
  Sat, 2001 Dec 1 15:56:32 *Lance Collister <w7gj@bigskyspaces.com>*

amfmtvdx list

- **[AmFmTvDx] Saturday HCI 40 Meter Net**
  Fri, 2001 Nov 30 22:10:04 *"Duane Fischer, W8DBF" <dfischer@usol.com>*
- **[AmFmTvDx] HCI Global Glow Tonight**
  Wed, 2001 Nov 28 10:14:29 *"Duane Fischer, W8DBF" <dfischer@usol.com>*

HardCoreDx Listserver

- **[HCDX] test tranmisson to North America 23-25 December**
  - *From*: "Konstantin Gusev" <gusev@itep.ru>

hsms list

- **[HSMS] Leonids pictures**
  Sun, 2001 Nov 25 18:00:47 *"Shelby Ennis, W8WN" <w8wn@arrl.net>*

milcom list

- **Re: [MilCom] Altitudes Question**
  Wed, 2001 Nov 14 09:26:49 *Ken Litton <klitton@highpoint.net>*

rec.radio.shortwave

- What radio should I buy? - various, rec.radio.shortwave news group

spooks list

- **[Spooks] N&O #43**

Sat, 2001 Dec 1 11:39:25 *ary@luna.nl*

- **[Spooks] Telephone History**
  Tue, 2001 Nov 27 17:06:20 *"Schlake (William Colburn)" <schlake@nmt.edu>*

swl list

- **[SWL] Radio Bangladesh**
  Sat, 2001 Dec 1 02:29:33 *Thomas Roth <th.roth@knuut.de>*
- **[SWL] ALL INDIA RADIO : B-2001 COMPLETE SW SCHEDULE**
  Fri, 2001 Nov 16 13:07:42 *Thomas Roth <th.roth@knuut.de>*

- Yatcht Boy 400 Problem - Joseph Lee, SWL list
  re: Yatcht Boy 400 Problem - Duane Fischer, SWL list

wun list

- **[WUN] Artic Radio**
  Sat, 2001 Dec 1 21:27:18 *Jack NeSmith <nesmith@bitstorm.net>*
- **[WUN] AERO: Arctic Radio ARINC on 8891**
  Sat, 2001 Dec 1 18:08:23 *"Mike Leary" <mleary2001@montana.com>*

- Info on Monitoring Shuttle Launch! - R.Baker & A.Stern via WUN Listserver
- Slow Scan TV Project on MIR! - from AE4RO & WUN Listserver

Selected Radio Monitoring Listservers with News & Tips

- Recent postings on **HARD-CORE-DX listserver** - archive for 2000

- Recent postings on **Rec.Radio.Shortwave** - on Deja.com
- Recent postings on **Rec.Radio.Shortwave** - on InfoCop.Com

Check out these listservers from QTH.net:

- Archive of Recent postings on the **AMFMTVDX** listserver
- Archive of Recent postings on the **ANTENNAS** Listserver
- Archive of Recent postings on the **ACARS** Listserver
- Archive of Recent postings on the **ACARSLOGS** Listserver
- Archive of Recent postings on the **ATLANTIC** Listserver

- Archive of Recent postings on the **BOATANCHORS** Listserver
- Archive of Recent postings on the **MILSURPLUS** Listserver
- Archive of Recent postings on the **FEDCOM** Listserver
- Archive of Recent postings on the **HEARSAT-L** Listserver
- Archive of Recent postings on the **LOWFER** Listserver
- Archive of Recent postings on the **MILCOM** Listserver
- Archive of Recent postings on the **SCANNER** Listserver
- Archive of Recent postings on the **SPOOKS** Listserver
- Archive of Recent postings on the **SWL** Mailing List
- Archive of Recent postings on the **WUN** listserver

Selected Radio Monitoring email lists on the Yahoo eGroups Listserver

- Amateur-repairs
- amfmtv
- antenna
- antique-radio
- armyradios
- Broadcast-Band-DXing
- cnjscanner
- connscan
- cothen
- dxbands
- FloridaScan
- frequencies
- ham4sale
- Hamfest
- HobbyScanning
- i95-scanning
- icdx
- ISSmonitors
- kc-scanning
- lf-vlf-elf
- MidlandPirates
- Milcom2
- MML
- MNscan
- MONIX
- monmouth-races
- mtl-scan
- MWDX-Midwest
- ni_scanner
- nnj-scan
- nordic-vhf
- NZSCANNERS
- OHfreqex
- OTTAWASCAN
- PacificRimDx
- PacNWMilCom
- phlscanner
- RailScan
- RealDX_(audio)
- Real-Scan-Audio
- safs
- scan-l
- scan-nyc
- SCAN-PA
- ScanAtlanta
- scanbucks
- ScanColo
- scancolumbus
- ScanCom
- ScanIndiana
- scaniowa
- scanner
- SCANnorCAL
- SCANSNE
- scansweden
- scantech
- scan_ky_wv
- scan_michigan
- SoCalTAlkRadio
- SWpirates
- swrs
- TampaScan
- TexasScan
- TpaBayscanner
- TubeSWL
- UKMidlandscanner
- usedhamgear
- UtahScanner
- VermontScanner
- vhfskip
- VirginiaScanner
- waveguide
- wpascanner

|**TOP**|**Antennas**|**AmDx**|**Clubs**|**Ham**|**Pirate**|**Rcvrs**|**UTE**|**Bookmarks**|**QSO**|**LogBook**|

AM BroadCast Band DX News

AM-DX News Flash

- AM-DX NEWS FLASH - June 07 2001 (62k)
- AM-DX NEWS FLASH - June 14 2001 (31k)
- AM-DX NEWS FLASH - June 28 2001 (100k)
- AM-DX NEWS FLASH - June 14 2001 (73k)
- AM-DX NEWS FLASH - June 28 2001 (57k) new

BCB Reports and DX peditions

- Archive of Recent postings on the **AMFMTVDX** listserver
- Directory list of **AMFMTVDX** listserver archives in Digest format.
- Subscribe to the **AMFMTVDX** Listserver - type **subscribe amfmtvdx** in the message Body

*Post a logging to the **AMFMTVDX** Listserver at: amfmtvdx@qth.net.*

- Canadian DX Message Board with BCB DX
- FM & TV DX skip announcements From Finland.

- **Broadcast Band DX Propagation Log**

An interactive log book for reporting BCB DX Openings!

- Report from Newfoundland 97 DXpedition - on Werner Funkenhoauser's site
- Mika Makelainen's DXpedition to Lemmenjoki, Finland

BCB DXing Clubs & Organizations

- *AMANDX* Canadian DX Website
- *IRCA*, International Radio Club of America Homepage -- IRCA Text Homepage

- CPC DX Tests from the IRCA and NRC
- *LWCA*, LongWave Club of America Homepage
- *MWC*, Medium Wave Circle home page
- *NRC*, National Radio Club Homepage
- *DXLC*, DX Listener's Club LW to SW Beacon List
- *WTFDA*, World TV/FM DX Assciation.

BCB DXing Lists and Loggings sites

- Werner Funkenhauser's *WHAMLOG* and Mediumwave DX Links. - Terrific website!
- William Demmery's Canadian AM Radio Directory - find those Canadian Unids here!
- David Onley's Mediumwave DX Page - in Australia
- Lee Freshwater's BCB DX Logbook
- Peer Axel's European MW page
- Peer Axel's Medium Wave Frequency Survey for Central Europe
- David Sharp's Most Excellent Homepage - Moderator AMFMTVDX Listserve
- Robert Kramer's Medium Wave Homepage
- Paul Ormandy's South Pacific DX Resource Page - good BCB DX resource
- Medium Wave Alliance home page
- DX midAMerica Web page
- Medium Wave DXing in Northeast USA
- Mizar's AM Radio page - w/loggings
- Joseph Cooper's Tuning Up Your BCB Monitoring Station

- FTP site with list of North American BCB stations (whamlog.zip)
- Search FCC Datadase for AM Radio Stations
- *Airwaves'* FCC Broadcast Station Database Search

- Bob's list of Long Wave DXing Links
- Industry Canada Frequencies Lists
- AMANDX AM/FM/TV UNIDs Message Board
- AE4RO, Tom's AM BCB QSLs
- **AM BCB DX Audio Files** - in RealAudio

- **AM Broadcast Band DX List** - from various sources (searchable)

- **Industry Canada's North America AM List** - from Werner Funkenhauser's Archives

- Broadcast Station Location Page by John Kodis - may be down..
- Chris Ridley's European And UK Frequency Lists - AM,FM
- Search Ultimate's US TV Station Lists

- **AM Broadcast Station Search** - from ASD at fcc.gov
- FM Broadcast Station Search - from ASD at fcc.gov
- TV Broadcast Station Search - from ASD at fcc.gov
- Other goodies on the FCC Audio Services Division site

- Archive of Recent posting on the **LOWFER** - Listserver

TIS and Extended Band info

- Bill Harms' TIS and HAR Frequency List web page
- Harry Helms' Extended AM Band Logging page
- Shawn Axelrod's North American XBAND List - AMANDX website
- FCC Authorized Expanded Band Allotment plan - on USNET by Mark Roberts
- **Dale Bickel's TIS Frequency Search** - from ASD at fcc.gov

TV and FM Monitoring Info

- Jeff Kadet's TV DX Photos - Great TV DX Site
- Buttle's TV Schedules of the World
- G4FBZ's DXTV at the height of Cycle 22 - DXTV Photos
- Fernando Garcia's TV DX via tropo - from Mexico
- Identifying TV DX from Mexico - from NLADxer
- NLADxer's TV DX EXHIBITION
- Ecola Newstand TV Station list
- TV Broadcast station search - from ASD at fcc.gov
- TV Guide Eastern Zone edition

- US TV Station lists.
- USA TV Online - Good TV/FM station Search
- Broadcast Station Location Page by John Kodis - search for TV stations
- Search Ultimate's US TV Station Lists
- Ultimate TV Homepage
- TV Carrier Frequencies in the US
- Pacific area TV video carriers
- US TV Carrier Frequencies
- TV Transmitters in Africa and Middle East - From Equinox
- TV Transmitters in Far East and Pacific - From Equinox

- TV Transmitters in Europe - From Equinox
- The Radio and Television Transmitters list
- The Radio and Television Transmitters Site

- British TV & FM Circle Homepage
- DDXLK, Dansk DX Lytter klub - with TV/FM
- *WTFDA*, World TV/FM DX Assciation.
- The FM & TV DX Plaza - From Finland.
- FM & TV DX Plaza skip announcements - From Finland.
- Fred Cantu's Mexico Radio & TV Lists
- WB2VVV's Radio Page with FM Dxing info

- The FM DX Web - w/syndicated lists
- Elliott Broadcast Services FM Database
- Radio TV Dial Pages
- Matt's Tallahassee TV DX Page
- Mikes's FM DX Page
- FM Broadcast station search - from ASD at fcc.gov
- Search the FCC's AM/FM database
- Industry Canada Frequencies Lists

- **TV/FM Skip Log**
- 26 mHz FM Relay Stations - posted on WUN

|**TOP**|**Antennas**|**AmDx**|**Clubs**|**Ham**|**Pirate**|**Rcvrs**|**UTE**|**Bookmarks**|**QSO**|**LogBook**|

Selected UTE Sites with News & Tips

- **Bob's UTE News Web Page** - on this site!
- Mike's OhioScan & DXing Page
- Spy Centre: Spy Numbers Stations
- Hugh Stegman's Utility World
- The Spooks Newsletter, Numbers and other oddities - Good numbers Info
- Ian Julian's Pacific-Rim Monitor page

- Marius Rensen's HF-FAX Web Page
- PY2VHF's UTE Webpage
- Rick "RD" Baker's UTE page
- World Wide Utility News, WUN Homepage
- The European Utility Newsletter
- Scramble Inteligence Service Bulletin
- Monitoring Times
- BDXC's WEFAX Information and Frequencies
- WUN Military Channel Designator's List
- Tigger's Military Callsigns list Page
- Richard Lacroix's Military Communications Home Page
- ITU Ship's database. Interogate for callsign, name or selcal.
- Aerobeacons web site
- Klingenfuss's Hot Frequency List
- DIGI and RTTY Decoder Information
- Plan of the Day Report for the Hurricane Hunters

- The Community Air and Space Report. - (satellite and shuttle info)
- TODAY at NASA, daily space news updates
- Receiving Space Shuttle Voice Communications - on USENET by H.Flashman
- IRC #monitor Information - on A Pile's Site
- Subscribe to VHFSKIP Listserver

- Archive of Recent postings on the **WUN** listserver
- Archive of Recent postings on the **MILCOM** listserver

- Al Waller's QTH.NET Mailing Lists - all the lists you could ever want!

UTE News and Information Page

Selected HAM Radio Sites with News & Tips

- **Amateur Radio Links and Info page**

- AC6V's DX News page
- AE4RO, Brother Tom's Homepage
- AMSAT News Service
- Al Waller's QTH.NET Mailing Lists - all the lists you could ever want!
- Bry's Ham Radio Files page
- Buckmaster World Wide Ham Call Search
- DARC - Deutscher Amateur Radio Club
- DK3XT's Make More Miles on VHF
- DXER.ORG, "DX NEWS" - Various Ham Info, News & Links
- Equinox HF News page
- Equinox HAM Radio Web site - Specializing in VHF/UHF
- kg7fu's Linux Ham Pages
- NCDXF/IARU International Beacon Network - 20 to 10 meter beacon info
- QSL.NET - Various Ham sites provided by Al Waller
- Tony Lacy's NuMorse / NuTest HAM Page - (Starting out Ham Info)

- Ham Radio FAQ #1 on Oakland.edu
- Ham Radio FAQ #2 on Oakland.edu
- Ham Radio FAQ #3 on Oakland.edu

- List of DX Packet Clusters
- OH2BUA DX Web Cluster World Desk
- The JA Web Cluster in Japan
- the DX Web Cluster in Japan
- the DX Propagation Logger - for posting Propagation Alerts.
- real-time Greyline Map - in black & white
- Near-Real-Time MUF Map - shows Greyline
- Last 25 WWV reports

Amateur Radio Listservers

- Archive of Recent postings on the **2M** Mailing List
- Archive of Recent postings on the **50MHZ** Mailing List
- Archive of Recent postings on the **NEWSVHF** Mailing List
- Archive of Recent postings on the **BUTLER VHF** Mailing List
- Archive of Recent postings on the **ELECTCHESTER VHF** Mailing List
- Archive of Recent postings on the **ROCKY MOUNTAIN VHF** Mailing List
- Archive of Recent postings on the **VHF-EA-CT** Spanish Mailing List

- Archive of Recent postings on the **HSMS** Mailing List
- Archive of Recent postings on the **METEOR-SCATTER** Mailing List
- Archive of Recent postings on the **222EME** Mailing List

- Subscibe to the UK VHF-CONTESTS Reflector
- Subscibe to the UK VHF-DX-DISCUSS Reflector
- Subscibe to the UK VHF-DX-WARNINGS Reflector
- Subscibe to the USA 6 Meter Reflector - Type **subscribe six-list** in the message body.
- Subscibe to the Japanese VHF Reflector - Type **subscribe 6m-dx** in the message body.
- Subscibe to the Swedish VHF Reflector - Type **subscribe vhf** in the message body.
- Subscibe to the Swedish EME Reflector - Type **subscribe eme** in the message body. - Info here!
- Send message to Moon-Net EME Listserver - or Get Mailinglist Commands

- Ham DX Info rec.radio.amateur.dx
- Ham Misc Info rec.radio.amateur.misc
- Ham Antenna Info rec.radio.amateur.antenna
- Ham Equipment rec.radio.amateur.equipment
- Ham HomeBrew rec.radio.amateur.homebrew

Amateur Radio Links and Information Page

Free & Pirate Radio Sites with News & Tips

- Alfa Lima International
- Andrew Yoder's HobbyBroadCasting.Com

- Clandestine Radio Broadcasting Web Page - List of Clandestines around the world
- Hermon Boel's, "Free Radio Stations" list
- the Free Radio WebRing - maintained by WKJCE
- Mining Company's Pirate/Free Radio Page
- Nick Grace's Clandestine Radio Intelligence Web
- Nick Grace's page on ClandestineRadio.com
- Radio Waves International Free Radio Web Page
- Chris Smolinski's PIRATE Page
- Peer Axel's Alternative Radio for Europe

Clandestine Radio Watch, CRW

- Clandestine Radio Watch Newsletter
- Pirate Radio Pages
- QSL Information Pages
- Martin Schoech's SRS Deutschland Radio Home page

Free Radio Network, FRN

- FRN Top Home page
- ACE Home page
- ACE Articles & News
- ACE Past Loggings page
- FRN Chat
- FRN's "Grapevine"
- Radio Free Internet - by Andrew Yoder
- RFI's Pirate News
- RFI's Pirate Station list
- Kirk Trummel's Workshop

Free Waves

- Free Waves Web site - in Italy
- Free Waves' "Hot News"
- Free Waves' Audio Files in RA & Wav

Radio 510 International

- Radio 510's Home page
- Radio 510's Relay Rates
- News from Radio 510
- Radio 510's IRRS Schedule
- Radio 510's WBCQ Schedule
- Listen to Radio 510's 1998 Special SWL Winter Fest Program. - in RealAudio

Swedish Report Service, SRS

- Swedish Report Service Home page
- SRS "The Free Radio Page" - Piracy info & resources
- SRS Pirate news
- SRS Pirate sounds - in RealAudio
- SRS Technical Information - transmitters

- **Various Pirate and Free Radio Bookmarks**

|TOP|Antennas|AmDx|Clubs|Ham|Pirate|Rcvrs|UTE|Bookmarks|QSO|LogBook|

DX Clubs with News & Tips

[jump to Clubs: B - C - D - E - G - I - L - N - O - R - S - U - W - Non-Club sites - Radio sites]

425 DX News, Amateur Radio Bulletin

- 425 DX News, Bulletin Page
- 425 DX News, Archive Search
- DX Calendar Page
- Links Page
- 425 DX News, Italy, Homepage

Alberta/Manatoba Radio DX Club, AMANDX

- AMANDX AM/FM/TV UNIDs Message Board
- Shawn Axelrod's North American XBAND List
- The GREAT WHITE NORTH Antenna
- Obtaining a QSL Verification from a Station
- Info on French and Spanish Pronounciation
- AMANDX Homepage

American Radio Relay League, ARRL - (Ham Radio)

- ARRL Web Site Index

- ARRL Awards Program
- ARRL Technical Information Service
- ARRL W1AW Bulletins
- W1AW Schedules
- Hamfest and Convention Calendar
- Learn About Ham Radio
- American Radio Relay League Homepage

American Shortwave Listener's Club, ASWLC

- DX SWL Programs
- Hot Spots Listening
- Shortwave Loggings from West Coast USA
- Your Special Listening Dates Calendar
- International Broadcasters list
- ASWLC club Message Board
- American Shortwave Listener's Club Homepage

Araucaria DX Group, ADXG

- ADXG, Club News
- ADXG, Araucaria DX Group, Amateur Radio club, Brasil - (in Portugese)

Asian Broadcasting Institute, ABI

- ABI's Asian Shedules page
- Asian Broadcasting Institute Homepage - in Japan

Asociacion DX Barcelona, ADXB

- Frequency Lists
- Mondo DX Bulletin #215
- Noticias DX Bulletin #025
- Utility DXing Links
- Radio Stations Direct in RealAudio
- Radio Statio RealAudio Archive
- ADXB, Asociacion DX Barcelona, Spain, Homepage

Asociancion Espana la de Radioescucha, AER

- EL-Dial Bulletin
- Emisoras International
- List of Shortwave stations using Realaudio
- AER, Asociacion Espanola de Radioescucha, Spain, Homepage

Asociazione RadioAmatori Italiani, ARI

- ARI, Amateur DX Info Page

- ARI, DX News Page
- ARI, Assiciazione RadioAmatori Italiani, Italy - (in Italian)

Association of Clandestine Enthusiasts, ACE

- ACE Home page
- ACE Loggings page
- ACE Articles and News

Association of North American Radio Clubs, ANARC

- 1999 ANARC Awards
- 1999 North American DX Championships
- ANARC Club list - with links
- Dave Kirby's ANARC SWL Net Home page
- ANARC Homepage

Assoziation Deutschsprachiger DX-er, ADDX

- ADDX Current Hour English Broadcasts
- ADDX Shortwave Schedules
- Radio Stations on the Internet
- ADDX Homepage

Australian Radio DX Club, ARDXC

- ARDXC, Classified Page
- ARDXC, Australian Radio DX Club

The Benelux DX Club - BDXC

- Benelux Homepages
- Benelux DX-Club "Monthly Bulletin"
- DX Programmes to Europe"
- English Transmissions to America
- English Transmissions to Europe
- WEFAX Information and Frequencies
- The Benelux DX Club Homepage

British DX Club

- British DX Club's Articles Index
- British DX Club's DX Program Guide
- British DX Club's African Station List
- British DX Club Homepage

British FM & TV Circle

- the "Skywaves" Bulletin

- CB and Amateur Radio Prefix List
- FM Receiver Reviews
- Latest DX Loggings
- Meteor Shower Calendar
- "On Screen" Long Distance TV Loggings
- British TV & FM Circle Homepage

Broadcast Listening Club, BCNEWS, Italy

- Media News
- Audio Gallery
- QSL Gallery
- BCLNEWS, BCL News Club, Italy

Canadian International DX Club, CIDX

- CIDX Bulletin, the Messenger
- Special Feature "Catch 26"
- Listen to the International Radio Report in RealAudio - 1530 ut Sundays
- Canadian Internation DX Club Homepage

Central Florida Listeners Group, CFLG

- Disney World Frequency List
- Central Florida Repeater List - (Zip file)
- CFLG Upcoming Events
- Central Florida Listening Info
- CFLG Member Homepages
- CFLG Links Page
- CFLG, Central Florida Listeners Group

Clube DX-ista da Amazonia, CDXA

- CDXA, Radio Station Recordings page - (in MP3)
- CDXA, Tropical Band Stations
- CDXA, DX Radio Programs
- CDXA, Receiver Reviews
- CDXA, DX Club List page
- CDXA, Clube DXista da Amazonia, Belem, Brasil Homepage - (in Portugese)

- CDXA's Loggings page
- Club DX-ista da Amazonia Homepage

DXing with Cumbre

- Cumbre Dx Bulletin Archive
- DXing With Cumbre Radio Program - in RealAudio

- DXing With Cumbre Radio Schedule - by Marie Lamb
- DX Station Audio Samples
- QSL Gallery
- Special Edition News - DX Items Too Hot to wait for the Newsletter
- Club Babalu
- Cumbre DX Pagina en Espanol
- Cumbre DX Homepage

Czechoslovak DX Club, CSDXC

- CSDXC, "DX Revue" Bulletin
- CSDXC, DX Publications
- CSDXC, Member Bandscans
- CSDXC, Technical Radio Schematics
- CSDXC, Czech DXer Email Address List
- CSDXC, Czechoslovak DX Club, Czech Rep. Homepage - (in Czech)

Danish Shortwave Clubs Internationa, DSWCI

- **DSWCI, Latest News**
- **DSWCI, Members Loggings**
- **DSWCI, Danish Shortwave Clubs International, Homepage**

Danish DX Listeners Club, DDXLK

- **DDXLK, Tips and Loggings**
- **DDXLK, DXing Book Service**
- **25 Mhz Frequency list**
- **Local Radio in Denmark**
- **Pics from Radio limfjord (for men only! Hi! Hi!)**
- **DDXLK, DX Articles - most in Danish**
- **DDXLK Links page**
- **Nordic DX Championships Page**
- **Niels Holst's Homepage - member**
- **Peter Witten's Radio-siden Page - member**
- **DDXLK, Dansk DX Lytter klub - most in Danish**

DX Antwerp, DXA

- **DXA's "DX MONITOR" - DX News compiled by Mark Vissers**
- **DXA's Shortwave Schedules**
- **DX Antwerp Homepage**

DX Clube do Brazil, DXCB

- **DXCB, DX Articles Page**

- DXCB, Loggings Page
- DXCB, Transmissions in Potugese
- DXCB, Utility Loggings
- Antique Radios in Brazil
- DXCB, DX Club do Brazil Homepage

DX Clube Paulista of Brazil, DXCP

- Logs Ondas Medias - BCB and SW loggings
- Onda Tropical - Tropical Band loggings
- DX Clube Paulista of Brazil Homepage

DX Listener's Club Norway, DXLC

- DXLC's "DX News"
- DXLC's Beacon List - LW to SW
- DXLC's "Solar Terrestrial Report"
- DX Listener's Club Homepage

Electronic DX Press, EDXP

- EDXP, List Archive
- Asia Link
- Bob Padula's Electronic DX Press, EDXP

El Dial, Spanish Listeners Club news

- EL Dial, AM BroadCast Band Loggings
- EL Dial, Shortwave Loggings
- EL Dial, Tropical Band Loggings
- EL Dial, Spanish DX Club News (Spanish)

European DX Council, EDXC

- EDXC, Conference page
- EDXC, Members page
- EDXC, European DX Council Homepage

Finnish DX Association, SDXL

- Raimo Makela's Tropical Band Station List
- Raimo Makela's Portable Shortwave Radio Reviews - in Finnish
- Radio Station Schedules and Frequencies - in Finnish
- Finnish DX Association Homepage - In Finnish

Federation of Mexican Radio Experimenters, FMRE

- Boletínes Dominicales
- Como Ser Radioaficionado

- IARU Info
- "ESTACIÓN DX" Radio Program
- RED NACIONAL DE EMERGENCIA
- FMRE, Federation of Mexican Radio Experimenters Homepage - (in Spanish)

German Signal Search Ring, GSSR - UTE Monitoring

- Digital Sounds Page
- Frequency Lists
- Number Station logs and audio
- Hardware Projects and info
- Medium Wave Loop antenna
- Decoder Software
- GSSR, German Signal Search Ring Homepage - (German & English)

Grupa DX Mediterraneo, Medi DX

- Intro to Long Distance Medium Wave DXing
- Antennas Page
- Medium Wave Stations from Spain
- Medi DX, Grupo DX Mediterraneo Homepage - (Spanish and English)

Gruppo d'Ascolto Due Mari, GADM

- GADM, DX FanZine
- GADM, Shortwave, Community and Alternative Stations in Italy
- GADM, Shortwave Stations on the Internet
- GADM, Italian DX Vocabulary
- GADM, Gruppo d'Ascolto Due Mari, Italy - (in Italian)

Gruppo Radioascolto Liquria, GRAL

- GRAL, Cover Photo of GRAL "Media News" Bulletin
- GRAL, QSL Column 2000
- GRAL, Italian DX Club Links
- Mediterranean Media News
- Gruppo Radioascolto Liquria, Italy Homepage - (in Italian)

Hard-Core-DX

- Last 10 Articles posted to Hard-Core-DX
- Search Hard-Core-DX
- Britti-Dx, Tampereen DX Club Page
- Distance-On-Line DX Page
- DXing Links Page
- Freeze, DXing Artic Style Page

- Latin American DX
- Medium Wave DX
- NordicDX Center's Antenna Info Page
- NordicDX Center's Andes DX Page
- NordicDX Center's DXer's Lab Page
- HCDX SWB, Shortwave Bulletin Web Page
- DX Club of Tampere Web Page
- Hard-Core-DX Homepage

Indonesian DX Club, IDXC

- IDXC, Indonesian Shortwave Broadcastings
- IDXC, DX Diploma
- IDXC, QSL Images
- Indonesian Radio Web **by Nick Grace.**
- Indonesian DX Club Homepage

International Broadcasting Bureau, IBB

- IBB, Jamming Sounds page
- IBB, Frequency and Language Schedules
- VOA, Voice of America Homepage
- RFA, Radio Free Asia Homepage
- RFE/RL, Radio Free Europe / Radio Liberty Homepage
- Radio Marti Homepage
- IBB, International Broadcasting Bureau Monitoring Homepage

International Correspondence DX Group of Australia, ICDX

- ICDX Mailing List Info **- (on eGroups)**
- ICDX Bytes and Bits Computer Column Archive
- Selected News from "Crossfire", the ICDX Bulletin
- Selected Pacific AM BC Station News
- "Power Plant" ICDX Equipment Reviews
- International Correspondence DX Group Homepage

International Radio Club of America, IRCA

- IRCA's Hot BCB Tips
- IRCA and NRC CPC DX Tests
- International Radio Club of America Homepage **- medium wave only club**

Irkutsk DX Circle

- Local Broadcasting in Irkutsk area
- Utility Meteo DXing in the CIS

- Broadcasting in Russia
- Irkutsk DX Circle Homepage

JA-DXing in Japan

- Jembatan DX Bulletin
- Yokohama DXing Index
- Russian DX Page
- Listen Points News
- JA-DXing Homepage - by Nobuo Takeno

Longwave Club of America, LWCA

- Longwave Message Board messages
- LF Utility Stations Resource page
- LWCA Homepage

Medium Wave Circle, MWC

- MWC Publications/Reprint Service
- Intro to long distance MW listening
- DXing NAVTEX
- Medium Wave Circle home page

Michigan Area Radio Enthusiasts, MARE

- MARE, Mid East Situation Info
- MARE, Shortwave Broadcasters Schedules
- MARE, Sony 2010 Faq
- Michigan Area Radio Enthusiasts Homepage

Minnesota DX Club, MDXC

- Loop Antennas - good resource
- Winter Shortwave Frequency List
- Pavek Museum of Broadcasting
- Minnesota DX Club Homepage
- James Dale's Homepage - MDXC host

Mohawk Valley Shortwave Listeners Club

- MVSWLC Clandestine Page
- What in the World? Page
- Articles and Special Reports (DX Camps)
- Mohawk Valley Shortwave Listeners Club Homepage

Nagoya Dxers Circle, NDXC

- NDXC, Newsletter Index

- **NDXC, Nagoya Dxers Circle Japan - (in Japanese)**

National Association of Shortwave Broadcast, NASB

- **NASB, Newsletter**
- **NASB, Members**
- **NASB, Associates**
- **NASB, National Associaction of Shortwave Broadcasters**

National Radio Club, NRC

- **NRC's International DX Digest directory listing - MW loggings**
- **NRC Publications and Reprints**
- **National Radio Club Homepage - medium wave only club**

New Zealand Radio DX League, NZRDXL

- **DX Forums Page**
- **Links Page**
- **Links featured innthe NZ DX Times Magazine**
- **DX Articles and Info Page**
- **Paul Ormandy's South Pacific DX Resource Page - good BCB DX resource**
- **NZRDXL, New Zealand Radio DX League**

North American Shortwave Association, NASWA

- **NASWA's Journal Highlights**
- **NASWA's Shortwave Listening Guide - by John Figliosi**
- **North American Shortwave Association Homepage**

Ontario DX Association, ODXA

- **ODXA's "Target Listening Guide" - by Harold Sellers**
- **ODXA's "Media Program Guide"**
- **ODXA's Sample columns page**
- **Ontario DX Association Homepage**

Play DX, DX News Magazine

- **Play DX, DX Clubs in Italy**
- **Play DX, Private MW and SW Stations in Italy**
- **Play DX, RAI Stations on LW and MW**
- **Play DX, Medium Wave Station in Spain**
- **SWRS, Shortwave Relay Service Homepage**
- **Dario Monferini's "Play DX" Homepage**

Radio Rama, Italy's DX Magzine

- **RadioRama, Web Site FAQ**

- RadioRama, DX Radio Services
- RadioRama, RAI Stations in Italy
- RadioRama, World DX Station Lists
- RadioRama, Latin American DX Page
- RadioRama's Homepage

Society to Preserve the Engrossing Enjoyment of DXing, SPEEDX

- Articles From Past Editions of SPEEDX
- Collection of DX Audio Files from Mauritius
- Daniel Sampson's Shortwave Broadcasts to North America
- DX and Other Interesting Programs List
- Interactive DX LogBook.
- DX QSO Link
- Tropical Band List
- SPEEDX Homepage

Society of Osaka Radio Audience, SORA

- DX Reports
- DX Links page
- Members Homepages
- SORA, Society of Osaka Radio Audience Japan - **(in Japanese)**

South Asia Radio Guide, SARG

- SARG, Radio News
- SARG, Frequency Database
- SARG, English Shortwave Schedules
- SARG, All India Radio Schedules
- SARG, South Asia Radio Guide Homepage

Swedish DX Federation, SDXF

- SDXF's "DX-Relaterat" - **Not in English**
- SDXF's DX Tips board
- Swedish DX Federation Homepage

SWL.NET, by Al Waller,

- Central Florida Listeners Group, CFLG
- Club Babalu Homepage
- Newcastle Scanner & Shortwave Group, NSG
- Radio China, All about radio in China
- Signal Surfer DX Club
- SWL.Net Master Index page - **List of all the pages on swl.net**

- **Archive of Recent postings on the SWL Mailing List**
- **Subscibe to the SWL Email List - type subscribe swl in the message Body**
- **Al Waller's QTH.NET Mailing Lists - all the lists you could ever want!**

UK Six Meter Group, UKSMG - (50 Mhz Radio Amateurs)

- Check the UKSMG 6m DXCluster
- 6 Meter Audio Beacon List - (listen in RealAudio)
- Listen to 6 Meters, 50110 Live with a FT650 From the UKSMG.
- UKSMG Announcements Page
- UKSMG Six News Archives
- What is Six Meters
- UK Six Meter Group Homepage

Union Radioaficionados Espanoles, URE

- URE EA DX
- ENLACES A PAGINAS DE RADIO
- LOS SERVICIOS DE LA URE
- MATERIAL Y PUBLICACIONES
- URE, Union Radioaficionados Espanoles, Amateur radio, Spain, Homepage - (in Spanish)

Universal DX League, UDXL

- UDXL Dial Scan page
- UDXL DX News page
- UDXL WRTH Update page
- The UDXL's DX Grapevine (Summer 97) - old but interesting
- Universal DX League Homepage

Umeza Broadcast Listeners Club Japan, UBCK

- Communications Receivers
- Frequency Program Guide
- DX Links page
- UBCK, Umeza Broadcast Listeners Club Japan - (in Japanese)

WorldWide DX Club, WWDXC

- WWDXC, WorldWide DX Club "TOP NEWS" - Compiled by Wolfgang Buschel
- WWDXC's Previous week's "TOP NEWS" - Compiled by Wolfgang Buschel
- AGDX, WWDXC's Parent club
- WorldWide DX Club Homepage

WorldWide TV-FM DX Association, WTFDA

- FM Radio Related Web links.
- WTFDA Member Homepages.

- WTFDA "MailRoom" Page.
- Treasury Of Techncal Articles.
- TV Related Web Links.
- WorldWide TV-FM DX Association Homepage

WorldWide Utility News, WUN

- WUN File Archives - Loaded with UTE monitoring Goodies
- WUN Special Topics Reports Archive - More UTE monitoring Goodies
- WUN Newsletter
- IRC #WUN & #MONITOR chat Information
- World Wide Utility News Homepage

[jump to Clubs: A - C - D - E - I - L - N - S - U - W - Non-Club sites - Radio sites]

Some Very Nice Non-Club Pages with DX News & Tips

- Sonny Ashimori's DX North Korea Page
- Hermon Boel's, "The World On Radio" - DX News
- Simon Collings' Radio Page - (language recognition pages!)
- English Shortwave Broadcasts to North America Page - By Daniel Sampson
- Sven Ohlsson's Shortwave Broadcast Schedules Page
- Eike Bierwirth's Radio Pages with SW Schedules

- Byron Hicks' Shortwave Radio Schedule Guide
- Hans van den Boogert's Radio China Homepage
- Literature of Shortwave Radio by Ed Janus - Reviews of SWL Books (excellent!)
- MondoRadio DX Club of Italy - Italian Shortwave Resources Page
- Paul Ormandy's South Pacific DX Resource Page - good BCB DX resource
- Listen to Paul Ormandy's DX Report on RNZI's "Mailbox" program in Realaudio
- Page 1700 Radio from DC to Light Large collection of links
- Raimo Makela's Tropical Band Station List
- Scan Cat Software and DXing files Page
- Klaus-Dieter Scholz's "www.dxing.de" DX Homepage

Peter Costello's Shortwave/Radio Catalog

- Shortwave Catalog Index
- Shortwave Catalogue AM/FM Listening page
- Shortwave Catalogue Radio Services page - (FAQs, Propagation, Clubs, etc)
- Shortwave Catalogue Radio Topics page - (Internet Radio, Scanners)

- Shortwave Catalogue Satellite Radio page
- Shortwave Catalogue Shortwave page - (Broadcasters, Ham)

Mark Fine's Fineware WWW page

- Mark Fine's Fineware link Homepage
- Mark Fine's SWBC Schedules

George Jacobs and Association

- George Jacobs NewsFlash
- George Jacobs Station Schedules
- George Jacobs and Association Homepage

Russian SWL and TV DX Page

- Russian Radio and Television Stations on the Internet
- Russian Radio and Television Stations list in Russian
- Russian Schedules
- Russian DX Publications
- Russian DX Clubs
- Whats New
- Russian SWL-Radio, TV and DX Page - (in Russian)

Sven Ohlsson's DX Web Site

- Sven Ohlsson's English Home page
- Sven Ohlsson's English Schedules page
- Hialosa DX News - by Sven Ohlsson
- "Torget" DX News - by Sven Ohlsson

Chris Ridley's DXers Toolbox

- Chris Ridley's DXer's Toolbox Home page
- How To... Page - (Verify, SINPO, Projects, etc)
- DX Theory Pages
- European and UK Frequency Pages - Am, FM, LW

Tom Sundstom's TRS Consultants

- TRS Consultants Home Page
- TRS Radio Page - Top Radio page
- DX News page - Good up to date DX News
- TRS Events page
- IRC #SWL info page
- TRS Links page - One of the Best!

Radio Station sites with News & Tips

Radio Havana Cuba

- Arnie Coro's "DXers Unlimited"
- RHC's Homepage

Radio Netherlands

- Real Radio Page - with Receiver Shopping Reviews and Listening Tips
- WRN, Radio Netherlands' "Media Network" Program Archives
- "Media Network" RealAudio Archive Page
- Radio Netherlands' Homepage

Radio Sweden

- "Media Scan" Webpage Communications Media News
- Radio Sweden Homepage

Voice of America

- VOA Programs in RealAudio Page
- WRN, VOA's "Communications World" Program Archives
- VOA IBB Monitoring Web Site
- VOA World Wide Web Home Page

Glenn Hauser's "World of Radio"

- Glenn Hauser's "World of Radio" Web Page & Schedule
- WRN, Glenn Hauser's "World of Radio" Program Archives
- Glenn Hauser's SW/DX Report

[jump to Clubs: A - C - D - E - I - L - N - S - U - W - Non-Club sites - Radio sites]

OUR COLLECTION OF DXING BOOKMARKS

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Antenna, Propagation, and Tech Info

antenna info and projects

- Archive of Recent postings on the **ANTENNAS** Listserver
- Directory list of **ANTENNAS** listserver archives in Digest format.
- AntennaX Zine Homepage
- Antenna Elmer - Wire antenna info
- Ham Radio - Antenna - Files
- Amateur Radio A to M - Files and Info
- Amateur Radio Antenna Resource - K3URT
- ACTIVE ANTENNA for the Shortwave Region - Good Construction Project
- ARRLWeb: The ARRL Publications Catalog (Antennas) - ARRL Info
- ORION's Antenna Tech and Simulations
- AC6V's Homebrew Antenna Page
- Build your own T2FD antenna, Kees van Engelen, The Netherlands
- K3KY's Limited Space, Flags and Pennants Antenna Page - for restricted areas
- NordicDX Center's Antenna Info Page
- K6QGH's Homepage with Antenna Resource Links
- Phone Line as SW Antenna - via Bill McFadden's page
- Antenna Info and Projects - on funet.fi
- Index of /pub/ham/antenna/ - Finland's FUNET Info
- A simple LONGWIRE Antenna - on AMANDX website
- Longwire Impedance Matching - from BADX
- The GREAT WHITE NORTH Antenna - on AMANDX website
- The DIPOLE Antenna / Info and Design - on AMANDX website
- Antenna Advice for UHF TV DXing - on AMFMTVDX by Neil Kazaross
- Discussion on BEVERAGE Antennas - on USENET by G.Kipple
- Myers Engineering International, Inc. Antenna Factors - Names and Terms
- Low Noise Antenna Connection - from BADX
- Grounding and FeedLine Info by John Doty - on Delphi Web
- Grounding Discussion - from BADX
- Review of ICE Matching Transformer - from BADX
- A Grounding System for Shortwave Listeners - on AMANDX website
- A Simple Anti-Static Device for your Antenna - on AMANDX website
- Bill's Ham Radio WWW Server

active antenna info

- Gary's Electronic Hobbyist Page - w/Antenna Projects
- R. Newell's Radio Resources, with Antenna circuits and designs
- Rainbow Kits ACA-1 Active Antenna - for sale!
- Naval Electronic Active Antenna MF-HF Reception - for sale!
- North Country Radio, Active antenna for portable radios - for sale!
- Ameco Corp products and services - sells active antenna!
- MFJ Enterprises, Inc. - sells antenna accessories

loop antenna info

- Loop Antennas - via MDXC
- Review of Radio Plus Electronics Quantum Loop
- Shawn Axelrod's 4 foot unamplified Box Loop design
- The AMANDX page with The BOX LOOP Info - on AMANDX website
- Bruce Carter's's AM Antenna Info
- Gerard's Tuned Loop Antanna
- LOOP Antenna Discussion - on USENET by various postings
- A Short and Easy MW LOOP Antenna - on USENET by R.Hardin
- Wakko's Radio Page/ - David Moisan's Carpet Loop Antenna
- Antennas West Home Page
- Kiwa's Pocket Loop Page
- Joseph Cooper's BCB page - with Passive Loop plans

propagation info

- Propagation Basics - on AMANDX website
- Solar Terrestrial Dispatch Homepage
- Near-Real-Time MUF Map - shows Greyline
- Aurora Map from the above site
- Current Aurora belt picturefrom uiowa.edu
- Space Environment Center - Boulder CO.
- Space Environment Center's Radio User's page
- US Naval Observatory Astronomical Applications Department
- GeoClock's Home Page
- WWV Indices - Current Flux count
- WWV Realtime Indices - current flux count

- WWV Alert and Warnings - current flux count
- Last 25 WWV reports

Radio Receivers and Misc Listening Info

radio receiver info

- John Lloyd's collection of Shortwave RECEIVER Reviews
- John Lioyd's Reviews on PY2VHF's webpage
- Dave's Radio Receiver Page
- Receiver Shopping List - via Radio Netherlands
- Shortwave Receiver Info - on funet.fi
- Receiver and Antenna Reviews - by Robert Kramer
- Basic Receiver Specs Defined - on AMANDX website
- Collins R-390 Resource homepage - by Chuck Rippel
- R-390 Improved Audio Modification - posted on USENET by Chuck Ripple
- Posts about DX390 Static damage - on rec.radio.shortwave
- DX440/ATS803a resource Page - by Jill Dybka
- DX440 helpful Tips - posted by JJ Hitt & Charles Mikelson
- DX440 Mod for inproved Gain using the Whip - posted by Frank
- Dave's Kenwood R-5000 User's Handbook
- GE SuperRadio - by Werner Funkenhauser
- David Moisan's GE SuperRadio FAQ - a must read!
- Joes Radio page - GE SuperRadio
- Sony ICF 2010/2001d 'FAQ' from MARE
- Sony 2010 filter mod- on USENET by JR. Crabtree

- Crystal Radios: Xtal Set Society
- Xtal Set Society Articles - by Joseph Cooper
- Build Your Own Crystal Shortwave Receiver
- Recent Posts about CRYSTAL RADIOs - on AMFMTVDX list
- Antique Radio Page: Articles - Build a "Foxhole Radio"
- military radio and Vehicle locator
- Boat Anchor resources - on our Bookmarks page

receiver accessories info

- Accessories primer for the Beginner Listener - on AMANDX website
- Add-On BFO Project - posted on USENET by Michael King
- Another Add-On BFO Project - on USENET by Hugo Caron
- DXtreme Radio Software Web Site
- K0JD's Ham Homebrew website
- HARRY's HOMEBREW HOMEPAGE
- RFIing Computers
- Rick's Modster Madness - (DX440, YB400, DX398, etc)
- Radio Mods from Oakland FTP Site
- Radio Mods from SUNY Buffalo FTP site
- Jamie Bucher's Radio Mods page
- QRZ.com's Radio Mods page
- AC6V's Technical Reference page
- AC6V's Radio Mods page
- Shortwave Converter Project by Bob Liesenfeld - on qsl.net
- Shortwave Converter Project - on funet.fi
- Build a Q-MULTIPLIER
- Build a CRYSTAL TESTER
- KB9JJA Heathkit Ham Radio Page
- MFJ Shortwave Products
- Helpful info about NICADS - posted on the Scanner Echo by Bill Cheek
- Sci.Electronics FAQ: Battery Info Menu
- Ramblings about NiCd Batteries

web controlled receivers

- Listen to a FT747 and a Icom PCR1000 in Sweden!
- Listen to an Icom PCR1000 and a SRT CR91 in Norway!
- Listen to 2 Meter Repeaters in Wash DC area w/R7000!
- Chilton's R8 Shortwave Radio
- SW440 in New York State
- Java Radio Server Homepage
- Listen to 6 Meters, 50110 Live with a FT650 From the UKSMG.
- Police Scanner.Com, listen to various Police and fire

- ***DIGI and RTTY Decoder Information***

- RTTY/FAX FAQ on Oakland.edu by N1KGH
- Packet Radio FAQ on Oakland.edu

miscellaneous listening info

- Radio Acronyms by Hugh Stegman (3000+)
- Introduction to Shortwave Radio
- Intro to LongWave Broadcast Stations - on AMANDX website
- The DXer's Toolbox - with Basic DX info
- The Literature of Shortwave Radio - Excellent Shortwave Book Reviews
- Obtaining a QSL Verification from a Station - on AMANDX website
- Info on French and Spanish Pronounciation - on AMANDX website
- To convert to UTC time, try this Univ of Illinois page!
- PLUG IN Music Reference Guide and Info - WorldWide Music Charts
- Caravan Music's Guide to Latin Music - Audio Clips
- Cuban Music Samples - Audio Clips
- La Romana On-Line Dominican Music Samples - Audio Clips
- the Sounds Of Shortwave - Audio Clips
- Welcome to Tiare Publications
- Monitoring Times
- Popular Communications
- Index of FTP.FUNET.FI:/pub/ham area - Top FUNET menu page
- QRZ.com's Ham Files Download page
- Index of /pub/hamradio/oak/arrl/bbs - Top ARRL menu page
- IRCA Bookstore and Reprints
- NordicDX Center's DXer's Lab Page
- NRC Publications and Reprints
- The Medium Wave Circle - Publications/Reprint Service

miscellaneous info and Articles

- A Visit to BBC's Hong Kong Relay - posted by Richard Buckby

Use DEJANEWS to search for USENET messages

I pick-up the FIDO NET SW-Echo from Fred Hatfield's DIGITAL COTTAGE BBS. (504-897-6614)

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Some of the Interactive Pages on this site

The DX QSO LINK is an interactive message page for the exchange of radio and DX information. You could try calling CQ someone may come back to you. If I'm on at the same time, we can talk.

For the informal sharing of UTE DX information! Also used as a supplement to our Internet DX LogBook.

For notification of SKIP OPENINGS and PROPAGATION ALERTS! Many radio amateurs visit this page every day.

Please submit a LOGGING to our LOGBOOK!

Other Interactive pages and Lists on this site!

DXProp | VHF QSO | MS Rocks | BCB Prop | UTE Log | QSO Link | DX Talk

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Please feel free to try out and use these pages!!!

- 16 Bit Netscape 4.08 (Win3.1)(8880k)
- 32 Bit Netscape 4.08 StandAlone (Win95/NT)(9968k)
- FTP site w/Recent Netscapes available here
- 32 Bit Netscape 3.04 (3430k)

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Noted author, **Joseph J. Carr,** has created a series of short articles on topics of interest to the shortwave listener. Universal Radio Research is pleased to provide them here in PDF format.

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If you enjoy Joe's clear and informative writing style and would like to learn more about shortwave antennas we recommend . . .

Radio Terms

Shortwave Radio

Introduction to Shortwave Listening

Tuning 150 kHz to 30 MHz

Selecting a Shortwave Radio

Reporting and QSLs

Receiver Reference

Modern Shortwave Receiver Survey

Favorite Tube-Type Shortwave Receivers

Scanner Monitoring

Introducing the "Action Bands"

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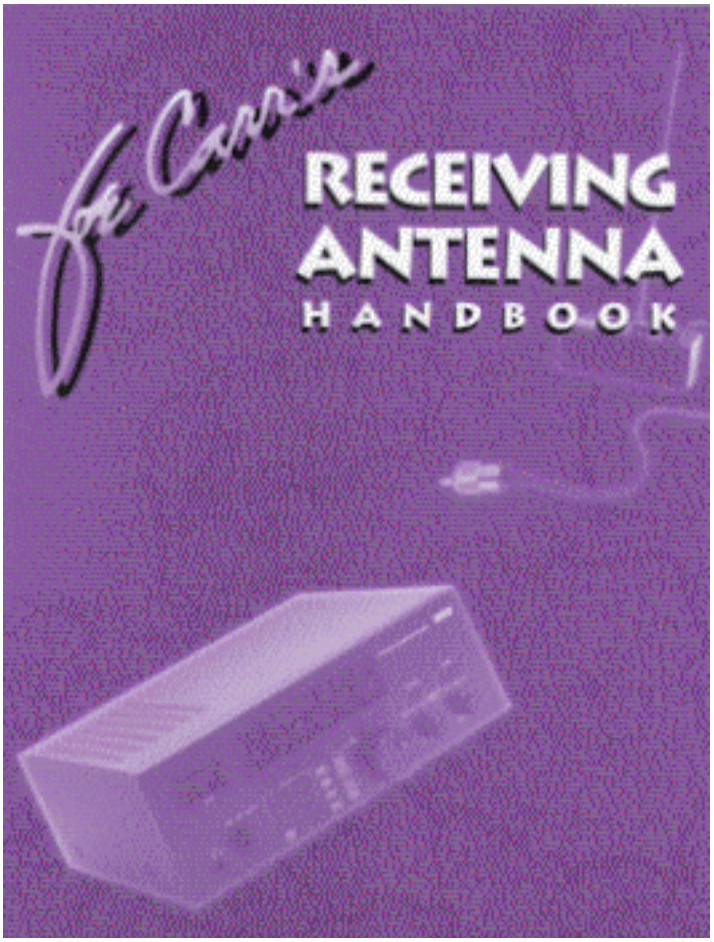

Joe Carr's Receiving Antenna Handbook

By Joseph Carr
This guide to high performance antennas is written in Joe's clear, easy to understand, friendly style. Arguably the best book devoted to receiving antennas for longwave through shortwave. An excellent book for the shortwave listener who likes to experiment with different antennas. ©1993 Hightext 189 pages.
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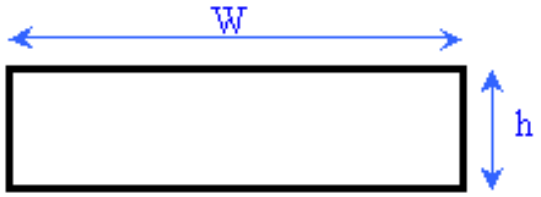

Parameters		**Input**
N		**turns**
w		
h		
a		
μr		
		nH

- **N:** number of turns
- **w:** width of the rectangle
- **h:** height of the rectangle
- **a:** wire radius
- **μr:** relative permeability of the medium

$$L_{rect} = N^2 \frac{\mu_0 \mu_r}{\pi}\left[-2(w+h)+2\sqrt{h^2+w^2}-h\ln\left(\frac{h+\sqrt{h^2+w^2}}{w}\right)-w\ln\left(\frac{w+\sqrt{h^2+w^2}}{h}\right)+h\ln\left(\frac{2h}{a}\right)+w\ln\left(\frac{2w}{a}\right)\right]$$

Loop Antennas

Loop Antennas

The Principles of the Loop Antenna article was in a newsletter of the MDXC. The next three were from a talk that Mike Bates and James Dale gave to the Northland Antique Radio Club's Radio Workshop at the Pavek Museum of Broadcasting.

What is a Loop and Why Use It

Construction Principles

What Can I Use a Loop For

Loops Another Look

Pictures of Home Built PVC loops

Loop Links

Principles of the Loop Antenna

A loop antenna is an antenna primarily for the AM broadcast and the Longwave bands. There are two different types of loop antennas, one is the ferrite bar (as in your am radio), the other is wound on an air core form. A loop antenna is very directional. The pickup pattern is shaped like a figure eight. The loop will allow signals on opposite sides to be received, while off the sides of the loop the signal will decrease or be nulled out. The nulling feature will allow you to remove a local station on a frequency and pick up another on the same frequency by removing the local signal. A loop may have an amplifier or may not.

Air core loop antennas come in many sizes. The larger the loop the more gain there is. A small loop will actually lose part of the signal. That is why most small loops will use an amplifier. There are two ways a loop can be wound, box or spiral. In the box or solenoid loop the plane of the winding are wound perpendicular to the diameter of the loop, so each loop is the same size. In the spiral loop the plane of the windings are wound parallel with the diameter of the loop, so each loop gets smaller as you wind into the center of the loop. A loop needs to be able to rotate to null out

a station. And a loop also needs to be able to till from vertical. This also helps in in nulling of a signal (altazimuth feature).

The number of turns the loop needs is determined by the size of the loop, the frequency range that you want to tune and the value of your tuning capacitor. The larger the loop the fewer turns you will need. A 4 foot loop needs 8 turns and a 2 foot loop needs 18 turns. The capacitor that is used is the standard AM tuning capacitor with a range of 10 to 365 pf. The tuning capacitor is used to tune the loop to the frequency that you want to listen to. When you are tuned in to the frequency the signal will peak. You may not be able to tune the full frequency range that you want to tune. So you will need to use a 2 section capacitor and switch the second section in. (more capacitance)

There are three ways that you can connect your loop to your radio.

One way is not connecting it at all. (This requires a portable radio with a internal loop antenna.) The field of the loop will radiate the peaked signal and you will be able to pick it up with no connection to the radio. You can move the radio around to get the best reception.

You can also direct couple to the loop. This way you connect to each end of the loop and also to the center tap of the loop. Using this method you will need to use it with an amplifier.

The last method is to use a pick up coil. This consists of one turn of wire that is placed inside the loop on the cross arms. This is then connected to the radio. The distance from the main tank coil can be determined by using a pocket radio and moving it inside the loop to find the place were the signal is strongest, and were it peaks sharpest.

In the past loops were made from wood. I have built them and found them to be heavy, clumsy, and flimsy. The mounting system were not very stable. In talking with Mike Bates, he came up with the idea of using PVC to build loops. PVC is easy to cut and because you use PVC molded parts, the loop that you make are is stable. By using PVC cement for some gluing and small nylon screws to connect parts you have no metal parts except the wire and tuning cap to throw the pattern of the loop off. Using PVC it helps to have a drill press, but if a person drills very carefully there should be little problems.

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What is a loop and why use it?

1). A loop antenna is a small multi turn loop of less than 1/10th wavelength in length. The loop is wound on a form, which may be either box (solenoid), or spiral (pancake) wound. The core material can either be air, or a powdered iron compound (Ferrite). The gain of a loop is much less than a longwire, but it has much less noise

pickup. A properly designed Loop primarily responds to the magnetic component of the radio wave. Note that noise resides primarily in the electrical component. A vertical antenna responds mainly to the electrical component.

2). Why use a loop?

A). No available space for a longwire antenna

B). To eliminate unwanted signals, and noise

C). Radio Direction Finding

D). To improve the performance of a simple receiving system, by providing pre-selection which improves image rejection, and adjacent channel selectivity.

3). History

A) 1915-1920's Early receivers used loop antennas, until they were discontinued in favor of long wire antennas, prior to 1930.

The loop antenna appeared again about 1938. This time it was used to eliminate the need for a longwire antenna, and to provide for safer operation of the small midget AC/DC sets that came into wide use at that time.

B). The first known use of a high performance loop antenna is the box loop made by Ray Moore in the mid 1940's(1) This antenna was written up in DX Horizons in 1960. The Moore Loop was wound on a 40" square box frame. Note: Ray Moore is the Author of the book on the history of Communications Receivers, and a new companion book on Transmitters.

C). The next major advance in Loop Antenna design came about as a result of advances by Gordon Nelson of the National Radio Club. The NRC Loop Antenna(2)was designed by Nelson in the Mid to Late 1960's time frame, Nelson was at M.I.T. at the time. The major advance that Nelson made was allowing the loop to rotate in the vertical as well as horizontal plane. The addition of the Alt-azimuth adjustment allows for the elimination of the effects of "wave tilt" and allows for much deeper nulling of certain stations. This loop was a 35" on a side and wound on a wood frame. In one form it utilized another Nelson first, a direct coupled Balanced amplifier using 2N4416 J-FET's with the outputs fed to a balanced feedline. The other version was link coupled to the receiver.

D). Sanserino Loop (1970-1985) This is a 2 foot Air core box loop designed by Ralph Sanserino, and later marketed by Radio West. This loop antenna used a Differential Amplifier similar to Nelson's except the output is not balanced. This antenna also has the Alt-azimuth feature. (available as a kit) The amplifier was later used in the Radio West Ferrite Loop Antenna (see below) .

E). Joe Worchester (1970-1977) a retired GE engineer developed the "Space Magnet ", a small 12" ferrite rod loop antenna using a Bipolar Junction Transistor amplifier(3). Nulls were not as deep as with the Nelson Loop. This is also probably the first loop antenna commercially available to the hobbyist, at a cost of about $45.00 if I remember correctly. Later versions utilized the Nelson Alt-azimuth

feature. This antenna also used a Faraday Shield around the Ferrite Bar.

F). Mackay Dymek (1974-Early 1980's) , Palomar Engineers (1977-current). These are small ferrite antennas made by larger commercial concerns. The Mackay Dymek was primarily for the Broadcast Band, where the Palomar has plug in coils for ranges from 10Khz to 15Mhz. Note that both of these antennas incorporated alt-azimuth design.

G). Radio West(1979-1985) 23" ferrite rod assembly using Sanserino Differential Amplifier, direct coupled, Has Alt-azimuth feature, $160.00 in 1979.High performance for its day, quieter than the "Space Magnet"

H). Quantum Loop (about 1990) by Gerry Thomas is a small ferrite rod less than 1' in size (length), with a high gain 40Db amplifier. has Alt-azimuth feature, in current production in various forms $135-$200.00.

I). KIWA Loop 1992 First Air core available since Nelson/Sanserino. Uses IC amplifier Opto isolated regeneration and varactor tuning. High performance, solidly built, in current production. $360.00.

J). RSM Communications (Ray Moore) RSM-105 (1994) A high performance transformer coupled, non amplified antenna described by Moore in Dec 1994 IRCA DX Monitor, Later in March 6 1995 issue of NRC DX News. Still in production? Price?? 35" spiral wound.

4). Electrical Design Characteristics

A). Two main types of Loops available 1). Directly Coupled and 2). Indirectly coupled (Transformer coupled) The Directly Coupled Loop has its windings directly attached to an Amplifier. Usually the main Tank Coil (parallel tuned circuit that forms the loop primary) in the loop is grounded at the center of the winding (center tapped), to allow for electrical balancing. The Amplifiers are usually but not always J-FET's, with 2 FET's in a Differential configuration, where the ends of the tank winding go to each FET gate. The Transformer coupled version uses a link winding to couple the signal to the receiver. This version can be amplified or non amplified.

B). The pick up pattern of a properly designed loop should be a figure 8 pattern. The null should be of the same depth, if the antenna is rotated 180 degrees horizontally (loop should not be adjusted for alt-azimuth, but left vertical 90 degrees from the ground). The 180 degree symmetry should be the same + or - one degree. If this condition does not occur the Antenna is not properly balanced. In a transformer loop balance deals with the signals being equal on both lines of the feed line (equal potential to ground). The feed line should preferably be shielded with the shield being grounded to the receiver chassis. If the line is affected by an electric field signal, a metallic object, or some other imbalance to ground, the loop will become unbalanced, resulting in a distortion of its pick up pattern. Balance is critical to getting the best nulls, and for precision Radio Direction Finding. The use of a broadband balun allows for better balance, but thought should be put into the design of the link winding, and receiver feed line, as well as the mechanical integrity of the coil.

C) The transformer coupled loop is the easiest to balance, especially if it is an air core loop. Ferrite loops are not as easy to balance due to the compression of flux

lines in the ferrite. These antennas seem to be somewhat more prone to pick up electric fields.

D). In a directly coupled loop, the balance is affected by the gain of the amplifying devices on either side of the center tap being equal. If they are not very close to, or equal, they will cause the voltage in the tank coil to be imbalanced with respect to ground causing the same undesirable effects that the feed line caused in a Transformer Loop.

E). Some loops utilize a Faraday shield to maintain balance (4) Usually a one turn loop. these are usually circular, and are used on ships and other areas where direction finding is necessary. An example of this antenna is the 160 meter loop wound out of coax described by Doug DeMaw (5) Using a Faraday Shield will affect the pick up gain, as well as the "Q" of the tank coil(3) Another variant of the shielded loop is the Mike Hawk Loop(6)

Also note that imbalance is sometimes referred to as "Antenna Effect"(4) Also please note that a balanced loop antenna can be spoiled to a cardioid pattern by putting a vertical sense antenna within its field.(4)

F). The amount of coupling (placement of the link turn) is critical to the performance of the Transformer Coupled Loop. The placement can vary depending upon the load that the antenna sees. The best way to obtain optimum performance is to experiment with various distances from the Tank Coil. Most designs call for this to be wound amongst the tank coil windings, however this coupling is much too tight for most uses, and allows for tuning to be too broad, Q to be too low, and sensitivity to be not quite optimal.

G). The physical size of the Loop Tank Coil affects the overall pickup (capture ability) of the loop. The larger the winding size the greater the pickup. Larger loops will also be easier to balance than smaller ones.

H). The Tuning Sharpness "Q" is determined by the size of the wire (surface area). The lower the resistance the higher the "Q" will be. The loading of the Tank Coil also affects the "Q". This more than wire resistance affects the Transformer Coupled Loop. In a Transformer Loop, the placement of the Link Coil in relation to the main tank (distance) determines the amount of coupling, and hence the loading of the tank circuit. The point of critical coupling can be found by varying the coupling link distance, while comparing tuning sharpness and gain. the critical coupling point will be found at the sharpest tuning before the gain starts to drop. Tuning will continue to sharpen (slightly), but gain will fall off more rapidly, as one couples more loosely (moving the link physically farther from the Tank Coil). Further improvement can be had by matching the load impedance to the link coil with a matching transformer. This can be done as part of a balun, or following the balun (lead-in side). For optimum performance all impedance’s in the system should be properly matched.

I). The L/C ratio and mechanical design of the coil should be considered when looking at a good design for a loop. The loop should be mechanically stable (wires not flopping loose) The distributed capacitance between turns should be kept low by proper design to allow for wide tuning range, but not too wide to degrade the length to diameter ratio of the coil. Note that the best null performance occurs with the best length to diameter ratio of the Tank Coil. A spiral wound coil affords the best performance in this regard, but does not afford as great a signal pickup as a

solenoid coil of the same diameter. (A Trade off)

Also note that the L/C ratio should allow for one 10 to 500pf variable capacitor to tune the whole Medium Wave Broadcast Band.(530-1700 KC)

J). Performance can be further enhanced if the amplifier following a transformer coupled loop is tuned. This provides still better image rejection, and adjacent channel selectivity. It is important that the amplifier be isolated from the loop by a transformer to maintain balance and pattern integrity.

K). Note that the spacing of the windings determines the inter-electrode capacitance. The wider the spacing between windings, the lower the capacitance, and the higher in frequency the loop will tune. the use of interlaced spreaders further reduces this effect (solenoid loop) provided that the spreaders are of sufficient width. Also note that the winding spacing is a compromise with the length to diameter ratio.

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Construction Principles

5). Mechanical design

A). Up to now, loops were made from wood. It was used because it was readily available and easy to work with. Wood does have disadvantages. They are, finding good wood, making accurate cuts, and heavy weight.

B). In a wood loop, the alt-azimuth tilting mechanism does not work very well. Wood loops use a bolt for the alt-azimuth tilt. It uses an arm that goes from the loop to a clamping setup on the mounting post. This does not work very well, as you need to tighten the bolt every time that you change the vertical tilt. The bolt will become loose, and on high angle tilts does not hold very well.

C). Most loops use a pipe mounted vertically with a dowel to do the horizontal rotation. This does not work well, as it allows the loop to move on it own. Wood will also wear after some use. This allows the loop to lose its square ness which can affect the loops pick up pattern.

D). The first loop I built was the Harley Loop(7). It is small spiral loop that was easy to build, but had no Alt-Azimuth feature, so the loop would not vertically tilt. It uses two cross arms with saw kerfs part way through to hold the wire.

E). I then built the 4 foot NRC Loop(2). This loop worked well, but the Alt-azimuth tilt needed work so I did some modification on the tilt mechanism. I wanted to design a tilt that would be easy to tilt and would stay in place. I tried different ideas and in my design I used a 3 inch PVC pipe for the mast and the loop head would tilt off that, this did work better but was not perfect.

F). While talking to Mike Bates(1995) about loops, He had the idea to build a large spiral octagon loop(5ft), out of PVC pipe and Alt-azimuth tilt it with a tripod. We built the loop, and this got my interest in using PVC for designing and building loop antennas. The tripod did not work very well due to the heavy weight of the loop head, but the performance was quite good.

G). My next design was a 4 foot PVC spiral loop that is collapsible. New features added to this loop was the use of a lazy susan for the horizontal rotation of the loop, however, you need to use a liberal amount of grease to give it tension. For alt-azimuth tilt I took a 3/4 inch PVC tee, reamed out the inside smooth, and cut a slit length wise. Through this I ran a piece of PVC pipe and with the use of elbows and tees attached it to the loop head. I then used plastic hose clamps to adjust the tension. This worked better, but still did not work very well. It is hard to get the angle just right, it does not move smooth enough.

H). Then I built a 4 foot Loop modeled from the NRC plans(2) out of PVC. For this loop I added the use of PVC in the base. I used the same type of Alt-azimuth tilt mechanism as the earlier spiral. To mount it to the loop head, I used a hole in the crossover of the loop to attach to the alt-azimuth mount. This was done to allow for having the ability to build different loop heads, like one for the longwave beacon band. This allowed the loop head to rotate on the mounting mechanism which made the loop unstable, and not very easy to use. I decided to make the mounting like the spiral loop, but to add the tees, I needed to cut part of the tee to mount it on the loop arms. When I assembled it for fit, I found out that cut out tees worked much better for tilting, and hose clamps are no longer needed. The alt-azimuth tilt mechanism now works very smooth and holds well at all angles.

I). The 2 foot loop was also built based on the NRC plans(8), it employs a gimbal mount for alt-azimuth tilt.

J). These loops are made entirely out of PVC except for the base plate that employs a lazy susan to rotate the loop. I built jigs to drill the holes in the cross pieces. A drill press helps a lot, but with very careful measuring and drilling, a hand drill may work. In my first loops I used PVC cement to glue the loops together. This cement sets up very fast, so you have to be very careful assembling it. I found out that some parts can be glued, but on some it is better to use a small nylon screw. This allows for you to align the pieces right on. To do this drill and tap a hole for the screw and run it though both pieces of plastic (PVC).

K). It helps to make a jig to wind the tank coil onto the frame. To accomplish this I mounted a Lazy Susan to a board, and ran a board with two vertical pieces of PVC Pipe The loop frame slides over the pipes, allowing the loop to be rotated while the wire is brought off of the spool in the same direction, while being laced through the holes in the frame. This helps greatly, in minimizing twisting of the wire.

L). Reasons for using PVC in loop construction:

1). Readily available, at low cost

2). Easy to work with, Saw and drill are main tools required, however, a miter box saw allows for clean perpendicular cuts.

3) Very symmetrical loops can be built, because the fittings are identical, and pre made.

4). Very low weight

5). The ability to come up with modular designs

6). The ability to design a collapsible loop that can be mechanically strong, allowing for easy transport

7). The use of spacers will tighten up the wires, so that they do not flop around, and distort the pickup pattern, as well as reduce inter-electrode capacitance. This makes for a very stable loop.

M). Notes:

Loop shapes: Triangle (Wedge), Square (Also called box, this is the most common shape) Octagon, Circular.

Note that the box loop is used because it is the simplest to build. The circular loop provides the nearest to the perfect shape electrically, but it is very difficult to fabricate a multi turn loop of this type. The octagonal loop is the practical compromise. Also note that the Octagonal is more difficult to fabricate due to it having 8 arms instead of 4, for the box loop.

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What Can I use a Loop For

6). Using the Loop practical applications

The small loop is a versatile antenna, and can be used for many different applications, here are a few.

A). The loop can be used for improving the performance of a poorly designed broadcast receiver. Depending on the type of antenna that is in the receiver determines how the loop can be attached. It may be attached via a transmission line if the set has wire or screw binding posts for the Antenna, or it may be inductively coupled (transformer) for a receiver using a very small loop. In the case of the receiver with a small loop the coupling rules apply as if the receivers loop is the link turn in the Transformer loop. (Note that the link coil is not needed for the loop to work for this, as the internal loop in the receiver is receiving the signal from the main tank circuit). The distance from the receiver to the larger loop will determine the amount of coupling, and tank loading. One can vary the pick up pattern by varying the angle of the receivers internal antenna to the external loop. The antennas provide maximum transfer of signal, and closest to a figure 8 pattern. when the pick up angle of the antennas is opposite parallel (90 degrees) (Beams of

the antennas aimed at each other) Minimum pickup occurs at 180 degrees. The pattern can be spoiled to a cardioid (null in only one direction) by varying the angle. Please note that the pattern will probably be somewhat spoiled from a figure 8 at the maximum signal 90 degree points. Please note that there are 2 commercially available products designed to inductively couple to the receiver, and improve its signal. These are the "Select A Tenna", and the "Q Stick" by Radio Plus (Gerry Thomas). However a 2ft or larger loop provides for much better performance provided one properly adjusts the coupling. A Large loop (4 ft) can cause a poorly designed receiver to overload. Loosening the coupling will allow for the overload to be eliminated. One must also be sure for proper operation that the loop is tuned to the same frequency that the loop is tuned to, or unwanted overload effects will likely be noted. All tuned circuits should be "aligned" to the same frequency. Also note that high Q tuned circuits can sometimes be touchy to adjust "spot on", some practice will probably be necessary. One can be amazed at the improvement in performance when using a properly designed loop. Stations can be brought from out of nowhere on a poor set. Images at the low end of the broadcast band will be cut down significantly or completely eliminated. As stated previously, adding a properly designed tuned amplifier further improves the performance of the system. The amplifier can be fed by feedline to a coupling link that couples to the receivers internal loop, or can be direct attached to a receiver with antenna connections.

B). A loop when properly balanced can be used to "null down" AC Line noise, TV Sweep Harmonics, or other locally generated interference. The Alt-azimuth feature helps greatly reduce, sometimes totally eliminating the noise. This feature is also quite useful for nulling of co-channel, or adjacent channel broadcast band stations. If properly balanced, nulls of over 60 dB may be attained by using the Alt-azimuth feature. Deep nulls can be difficult to find and maintain. A larger antenna allows for one to find the null more easily due to the larger pick up(field) created by the loop. Loops of 2 ft and smaller in diameter, can be quite touchy to null, and electrical balance can be quite hard to attain. Hand capacitance can also affect the null in these small loops, causing the null to move as ones hand is moved away. This effect is minimized when using a large loop, as your whole body is within the pick up pattern of the loop, and it will be less likely to distort the pattern. One needs to be 6" to 1’ away from the small loop(2ft and smaller) to avoid the hand capacity effects. It is also notable that nulling works best on local ground wave signals. Distant sky wave signals can be more difficult to null. It is difficult to get a null of greater than 30 dB on a sky wave signal at the top end of the broadcast band at night. For Sky wave, phased antennas provide for much better nulling, but are much more complex, and difficult to operate. Also note that the higher the Q of the tank coil, the sharper the null. Sometimes the null will be excessively sharp, and difficult to find, or the null will be so narrow in bandwidth that the carrier of a station will be deeply nulled, but the sidebands will be well received as slop(splash). This affect is more noticeable in small, or amplified direct coupled loops.

C). Radio Direction Finding

One can accurately direction find signals provided that the antenna is properly balanced as described above. The general concept is that the deepest null will be in the direction of the signal being checked. You cannot use the Alt-azimuth feature, you must keep the loop perpendicular 90 degrees to the ground. An accurate compass, and a marked 360 degree circle can be used to pin point the exact bearing that the signal is coming from.

Bibliography from the three articles above can be found at the bottom of this page.

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Loop Antennas Another Look

The last 30 years have brought about much refinement in the design of loop antennas. Starting from the basic box loop described by Ray Moore, major developments over this time are; The NRC 4ft Alt-azimuth loop, the Space Magnet, Sanserino Loop, Palomar, Mckay Dymek, Radio West, Quantum, Lankford, Kiwa, and RSM 105, and 103. As time has progressed, so has the design of Receiving Equipment, from the R390A, HQ-180, and SX-122 and Zenith Trans-Oceanic to the Sony 2010, Drake SW-8, Drake R8-B, and the AOR7030 Plus. Antenna needs have changed, with today's broadband front ends, and synthesizer phase noise a concern, a high performance loop, or other means of pre-selection is more important than ever.

We will show a slightly different twist on the same basic loop antennas of the past, with a couple of refinements, as well as construction details of our antennas.

To explain our antennas we want to start with the design criteria necessary to improve the modern communications receiver, as well as consumer grade radios such as, the Super Radio III, the Radio Shack Optimus, and most other portable short wave/broadcast receivers.

Important loop criteria have been explained before in the pages of DX News, and the NRC Antenna Manuals, however, a review is in order. It is our opinion that there are 4 basic parameters that loop performance should be based upon; 1). The loops signal to noise ratio. 2). The electrical Balance. 3). The selectivity or "Q" of the loop. 4). The mechanical rigidity/integrity of the coil assembly, and Alt-azimuth mechanism.

Signal to Noise Ratio

Most efforts during the last 30 years have dealt with making loops smaller, to allow them to be used by the DXer who has limited space. S/N ratio has suffered as a result. The use of direct-coupled balanced FET amplifiers, and smaller, and smaller loop coils means that the bulk of the work in the system is being done by the amplifier. If you capture a very tiny signal, and add some amplifier noise to it, you have degraded what signal that you have to the point that you may bury a signal slightly above the noise floor. A rule of thumb would be to use no more amplification than is necessary. It is better to make the coil larger to enhance the capture area, and insure that what amplification is used is as low gain, and low noise as possible. The small loops are probably OK for most uses, but when you want to extract the last decibel out of the ether, a larger loop that is properly designed will be best.

Electrical Balance

The electrical balance of the antenna insures that the current at the termination of one end of the loop tank coil is of equal magnitude and opposite polarity to that at the other termination of the loop coil. (A is equal and opposite B) When properly balanced the deepest possible null will be obtained, with the loop. Please note that balance is quite difficult to attain. Anything connected to the tank coil (or other metal brought physically near it) other than the resonating capacitor, can throw this balance (equal and opposite) off. This distorts the theoretical figure 8 pattern of the loop. If a link turn is used to couple the loop to the receiver, this link and the transmission line must be balanced, or coupled to an unbalanced line (Coax Cable) using a Balun. The link coil should be balanced, as well as the main tank coil. Using a balanced FET amplifier on the tank coil will throw off the balance if care is not to insure that the FET's are not exactly matched in their gain and transconductance. Not to mention that an amplifier not properly balanced, and running at excessive gain will be prone to create intermod products which degrade further the performance of the system. If a loop antenna seems to have a problem with hand capacitance it is a pretty good bet that it is not properly balanced. Refer to Nelson's article for detailed hints on how to attain balance.

Selectivity

The "Q" or quality factor of the tank coil will determine its selectivity at resonance (the tuned frequency). If the "Q" of the tank coil is loaded (reduced by the effect of a load on the coil), the "Q" will decrease, and the selectivity of the loop will decrease, or broaden. In the late 60's Nelson devised the balanced FET amplifier as a way to minimize the loading of the tank coil. This allowed for selectivity that was so sharp that a loading potentiometer was added across the tank coil to reduce the "Q" so that the loop could be more easily tuned. Prior to this, loops were of the transformer variety, with the signal being coupled to the receiver via a link turn, wound amongst, but not attached to the windings of the main tank coil. This process did not take into full account transformer theory, as the loop is now a transformer due to the link coupling. The main drawback of the early designs is that they did not use the coefficient of coupling when designing the loops. Moving the winding away, somewhat from the main winding allows for less loading. Maximum energy transfer from the tank to the link would occur at "critical coupling". The load impedance also affects the loading, and should be matched to the impedance of the link turn, as well. As stated before the link should be balanced. A balun, and matching transformer should be used with a modern receiver with a 50 ohm coaxial input. The distance that the link turn is from the primary tank coil greatly affects the performance of the loop. The "Q" can be greatly improved, as well as the S/N ratio if the link turn is placed at the critical coupling point from the main primary tank winding. This distance from the main winding can be approximately determined prior to winding the link turn using a pocket radio. Tune the pocket radio into a station that is within the tuning range of the loop. Start out with the pocket radio placed facing the plane of the loop (see fig 2) right against the loop winding, rotate the loop capacitor for a peak (maximum signal) on the pocket radio. Now move the pocket radio ½" from the winding and re-peak the loop. Observe how sharply that the loop tunes. Move the pocket radio away from the loop in ½" increments. Observe how sharply the loop peaks on the pocket radio, as well as the signal strength at each point. The loop should peak more sharply, and increase its gain as the radio is moved away. The point of critical coupling is attained when the signal is at maximum, the sharpness may still increase somewhat, but the gain will fall off more rapidly as the radio is moved away. Note the critical coupling point, and wind the link coil this distance from the main winding. This process can also be used

when passively coupling the loop to a radio using a ferrite antenna, or when using a device such as a Select-A-Tenna, or a shotgun loop , or "Q" stick with a radio with a built in loop.

Mechanical Integrity

Another consideration when building a loop is the mechanical design. This is often overlooked, and can affect the loop balance if the mechanics are sloppy. There are two different types of loop coil designs, The solenoid or box wound, and the spiral or pancake wound. Each type has several advantages, design trade offs, and dis-advantages. The box loop has a higher gain for the same diameter, but is more difficult to balance. With this type of loop there is a trade off between the inter-electrode capacitance and the length to diameter ratio. Spreaders can be used to cut down on the inter-electrode capacitance, and to maintain coil rigidity. Note that the better the length to diameter ratio of the tank coil, the nulling ability is enhanced and balancing is easier. The spiral loop has the advantage of almost perfect length to diameter ratio, as well as being easier to balance. The main drawback of the spiral is its lower gain than the box loop. Also, if an amplifier is used, it is much more difficult to tap the tank coil at its center. An amplifier can be used more practically with the spiral by attaching it following the balun and matching transformer. This way the amplifier is isolated from the loop, and the undesirable unbalancing effects can be avoided. Note that an amplifier should be used only when necessary, and should be as low in gain as to improve signal strength on very weak signals, where not using it would yield them unreadable. It is important that the loop antenna be well constructed mechanically to insure that the wires do not flop around, to distort the balance, as well as to prohibit the need for re-winding. We have switched from wood to PVC in our designs, with a minimum of metallic objects near the tank, and link coils. Note that metallic objects within the near pick up field of the loop will induce a voltage into the coil unevenly and throw it out of balance.

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Links to further loop information.

- Kiwa Has the Pocket Loop, mods for your receiver and filter modules.
- Select-A-Tenna Has some low cost loop antennas you can buy.
- Terk Home of the Terk loop and other antennas.
- Wellbrook Has a line of LW, MW, SW loops for the great outdoors.
- Palomar Has a loop with different loop heads in different ranges.
- AOR LA-350 Active loop available at Grove.
- AOR Their site for the LA-350
- Radio Plus+ Home of the Quantum Loop.
- Belar LP-1 and LP-1A AM shielded loop antenna
- Torus Tuner Loop Antenna is available in LW, MW, and SW.
- Twin Ferrite AM Antenna Is available at C. C. Crane

- Long Distance MW Listening Great info on the Radio Nederland's site.
- DIY MW Loop On the Radio Nederland's site.
- Ramsey Signal Magnet Noise Reduction Kit
- Mark Connellys page of phasing units and amplifiers for radio
- Loop Antennas On the HCDX site
- AM Box loop antennas by Bruce Carter.
- AMANDX Is another construction site.
- Hula Hoop Loop Antenna has plans using a hula loop.
- LF receiving loop A large homemade loop.
- AM Shielded Loop From Radio Magazine.
- Mag-Loop Antenna Designed for SW it can also transmit.
- Receiving Loop Aerial for 1.8 MHz Is a shield loop out of coax.
- Joe Carr's Tech Notes Has articles on antennas.
- VLF Loop A loop for listening to solar activity.
- PVC 4-7 Plans for a NDB loop.
- Loop Theory Is an excellent article on loop antenna theory.
- AM Loop Calculator Figure out what your loops should tune.
- NRC Has many book on loop antennas.
- Vans Think Tank Contains a good list of antenna links.
- NRSC AM bandwidth measurements with the loop antenna.
- The Electronics Hobby Page Another site with a excellent listing of antenna and DXing links.
- AM Loop Antennas Plans, links and theory.
- AM Tuner A tuner that you can build from tubes.
- The Electronic Hobby Page Has an extensive list of loop and radio information.
- Small Transmitting Loop for the HF band also has links to other loop sites.
- Dave's Loop Antenna He made this loop.
- LF Loop Plans for a 10 foot loop plus other LF information.
- Loop Antenna A circular antenna that VK2ZAY built.
- Low Noise Coax Shielded Loop for 160 to 10 Meters.
- N5ESE's Plans for a shielded loop receiving antenna.
- Loop Amplifier Build this amp to boost your loop.
- Loop Group Join this group on loops antenna on Yahoo.
- The Toroid King Has toroid to build your baluns they also have other parts.
- Amidon Another source for toroids.
- AM Broadcast Band Antenna Plans for a Active whip Antenna.
- AM Radio Loop Antenna A kit that you build from MTM Scientific.
- Active VLF Loop Amp Loop amp with negative resistance.
- Balanced Loop Preamp Give that loop a boost.

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This page was last updated on 08/03/04.

Any comments or suggestions can be made from my E-mail Page

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2). NRC Antenna reference Manual Vol 1 Dec 1995 Edition

"NRC Alt-azimuth Loop antenna P6

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"HQ tests the Space Magnet" P40

4). ARRL Handbook 1988 Edition P39-3

5). QST Magazine July 1977 "Beat the Noise with a Scoop Loop"

Doug DeMaw

6). NRC Antenna Reference Manual Vol 1 Dec 1995, "The Hawk Loop"

7) NRC Antenna Reference Manual Vol 2 Dec 1995 "The Harley Loop" P 11

8). NRC Antenna Reference Manual Vol 1 Dec 1995 P21 " The NRC 2 Foot Loop"

Suggested Reading:

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2). National Radio Club Loop Antennas Design and theory 1995

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AM radio reception tips and links

Home

Here are several original suggestions I discovered for AM radio reception. After these tips are links to pages about improving AM reception in your home and on a separate page there are links for better AM reception in your car. In both cases this is not just a list of links, I have provided commentary which brings together and organizes the web pages. I have recently added a page of hints and links for better FM radio reception, and bringing in EWTN on short-wave.

Finally, and best of all, I have collected tips from many other web pages and added my own tips to form what is probably the most complete one web page collection of AM radio reception tips on the Internet.

This page was written to help Catholics listen to low power Catholic AM stations, but physics is physics, so they will work for anyone. Because I am not a radio hobbyist and I am simply interested in communication the tips are simple, practical, and inexpensive.

Home and office links- Car and truck links- My original tips
FM tips and links- Complete AM radio reception Tips

Original tips for better AM radio reception

1. Turn treble down, bass up for AM talk
2. Record the AM signal when it is strong
3. Most sources of interference are weak
4. Tip the radio to reduce interference
5. A loop antenna helps a lot when regular antenna is weak.
6. The best position for a loop antenna
7. A comparison of some good reasonably priced equipment
8. Old radios do not get all of today's AM band
9. A good shortwave radio is often a great AM radio
10. Are you really interested in that station? Try before you buy.
11. Mark the position of your station on the dial
12. Experiment, try different things

1. If you are listening to talk radio turn the treble all the way down and the bass all the way up. Or if there is only one control marked tone turn it all the way to the low end. This will give you clear, easy to understand voices. This tip really helps a lot. I usually listen to music with the treble and base in the neutral middle position if the station is strong. I assume that is the way the musicians intended it.

2. Many weak AM stations, including many Catholic AM stations, cut their power at night, and you may get interference at one time during the day but not another. So you may be able to get a station during the day when you are at work, but not when you are free to listen to the program. You can use an automatic light timer, the type that is used to fool burglars into thinking you are home, to record radio programs when you are not at home. I have a popular web page giving the details of this idea and information and links for other methods of timed radio recording.

   The pilot of the Airwaves liked this idea so much that he put it on his AM radio reception web page. This is the only one of these tips you will find off of this site. The Pilot has a great page and has done me the honor of linking back to this page.

3. Many web sites list many sources of interference, florescent lights, televisions, computers, etc. I have been testing this and found that most of the commonly listed dangers are real, but the interference disappears if the radio is more than a foot, 30 centimeters, or so from the source of interference.

   But sometimes a source of interference causes problems over a much wider area. For example, the people who lived down stairs from me at my former apartment had a TV that produced a loud buzz even though the TV was a good 20 feet away from the radio. But the much larger TV in our apartment which was five to ten feet away was no problem. So most of the time the normal sources of interference are a minor problem, but sometimes one of them is a big problem. You should treat the common lists of interference sources as a list of suspects, not a list of convicted criminals.

4. You can greatly reduce interference by pointing either end of the rod antenna in your radio directly at the source of interference. This is very important, but not at all original.

   This is perhaps a more original tip, if the source of interference is higher or lower than the radio you may have to tip the radio to point either end of the antenna at the source of interference.

For example, if the interference is downstairs you may need to prop one end of the radio on a book and adjust it so that the radio angles down to aim the end of the antenna at the source of interference. I am not sure this is all that original, but maybe it is, and it helped with that TV downstairs I mentioned in the last suggestion.

5. I have bought a Radio Shack loop antenna which is now being discontinued and have had a chance to experiment with it. With a cheap radio the Radio Shack loop can make a big difference. I pick up the radio and move it away from the antenna and the station disappears all together, reappearing when I move the loop back. But with a good radio like the GE Superadio it is difficult to find any difference.

   Many web sites will tell you that the antenna is more important than the radio, but good radios often have good antennas built in. The GE Superadio has a large ferrite antenna built into the back.

6. You get the best reception when the loop antenna is placed so that if it were a wheel it could be rolled toward the broadcast tower.

   This is the opposite of how you use the regular AM antenna in the back of your radio. The antenna in the back of the radio should be placed so it is perpendicular to the signal. Think of it like a sail that is catching the radio waves. If the signal comes from the north then the ends of the radio should point East and West, and the back of the radio should face North or South.

   A web page on loop antennas said the loop must be perpendicular to the internal antenna. I have tested this and found that what is relevant is the orientation of the loop antenna to the broadcast tower not the radio.

   If the loop is not wired to the radio it will have to be close to the radio. If the loop antenna and the radio form a T, with the front or back of the radio facing the tower you will get an optimal signal, unless there is a source of interference.

7. I have had a chance to test and compare some equipment because other members of my parish had key pieces of equipment. The Select-A-Tenna did work better than the Radio Shack antenna. It also costs about a lot more, about $60 for the Select-A-Tenna. The Radio Shack loop antenna may presently be available for $10 or $20 dollars, but the antenna has been discontinued and Radio Shack is selling out.

I was not able to tell much difference between the CCRadio from Crane and the GE Superadio III. But perhaps there is a difference between the CCRadio and the GE Superadio that I did not notice. The CCRadio is digitally tuned which should save you quite a bit of time over the years if you switch stations a lot. A note in my guest book says that the earlier versions of the GE Superadio were the best, and beat the early CCRadio.

If you listen to a lot of AM on hard to get stations it may well be worth it to pay an extra hundred dollars for even a small difference. The average person listens to over a thousand hours of radio a year. If you are an avid listener you could easily listen to more than 10,000 hours in the next decade, in which case the extra cost is a penny an hour.

On the other hand the CCRadio costs about the same amount as a great short wave radio and the great short wave radio might be almost as good as the CCRadio at bringing in AM. More on this below.

A note on the proper spelling of these products, useful for searching the web. The GE Superadio is spelled superadio, not superradio, or super radio. The CCRadio is not spelled CC Radio or C.C. Radio. The GE Superadio was originally produced by GE but has been produced by Thompson Electronics for many years. GE does not produce many or perhaps any of its home communications gear, but at least some of what it puts it's brand on is exceptionial. If you are looking to improve your TV reception, particularly UHF, I have found the Optima TV antenna really works wonders, but I digress.

Here is a web site that provides an extensive comparison of the GE Superadio and the CCRadio.

8. In 1991 the FCC expanded the AM band to include 1605 to 1705. Earlier AM radios did not have those frequencies, so if you are searching for a station in that range you will need a newer radio. The only EWTN station with this problem is 1620 in Sacramento. The only other Catholic station I know of is 1670 in the Los Angeles area which does Spanish programing.

9. Good short-wave radios are frequently good AM radios. This is particularly important to Catholic radio fans because EWTN provides the exact same programing that is broadcast on Catholic stations by a short-wave signal that anyone can pick up.

Many weak AM stations, including many Catholic AM stations have a much stronger signal during the day, but must cut their power at night. The Catholic station which I used to get best, KSMH cuts their signal from 10,000 watts to 1,000 watts at sundown. After sundown you may lose the AM signal but it has commonly been believed that short-wave radio works best when the sun is not shining. To the degree that is true a short-wave that is better at night then the combination of AM and short-wave will provide you with EWTN 24/7, but actually I find that EWTN short-wave sometimes works quite well in the day time but you have to listen to it on a different frequencies. EWTN broadcasts on different frequencies at different times of the day.

If you do get a short-wave radio it may have to be a new one, because EWTN has in the past, and may still, be broadcasting on a new part of the short-wave band. As they change the frequencies the broadcast on from time to time the situation changes.

As a great short wave radio can be had for under 200 dollars you should think carefully before spending that kind of money or more on an AM radio.

People who are not fans of Catholic radio might find the short-wave option interesting if there is short-wave programing similar to the programing that they hope to get on AM.

The more expensive AM equipment is popular in places like Alaska where relatively isolated people have great difficulty picking up local news.

I have more information on short-wave for EWTN here.

There is another option, Sirius Satellite Radio, which is adding EWTN in English and Spanish to its service. Once again one should look at this before spending hundreds on a very high end AM radio.

It also might be mentioned that DirectTV and Dish Network now carry EWTN in English. This is a television service not radio so I will leave it at that.

10. Before you spend a couple of hundred dollars to bring in a station you might want to find out if you really like it. As mentioned above, the average American spends close to a

thousand hours a year listening to radio according to the Statistical Abstract put out by the Bureau of the Census. The majority of that is FM, but a large mminorityis AM. If you are a radio fan, which you maybe if you have read this far, you might be spending more than a thousand hours a year. So if you listen to something hundreds of hours a year for several years even a couple of hundred dollars is dirt cheap. If you quickly lose interest it can be quite expensive. So how to check out the station without buying the equipment? Here are several ways.

You maybe able to listen to some short-wave stations and even distant AM and FM stations on the Internet to test your interest. If you have broadband you may simply want to listen to the station this way and skip the equipment, but if you have a dial up modem you will probably not want to tie up your phone line for hours at a time on a regular basis just to save a couple of hundred dollars on the radio equipment that could bring the station in. But even listening on the dial up modem is a good way to try the station before you buy the equipment.

Most libraries have public access to the iInternetand you maybe able to listen to the station that interests you while surfing the Internet at the library.

If your normal travel by car brings you closer to a station that carries EWTN or any other channel that interest you this provides another opportunity to try before you buy. For example if you live in the San Francisco Bay Area and are thinking of getting short-wave to bring in EWTN you could listen to EWTN on 1620 AM in Sacramento when you are traveling through the valley near Sacramento. You can check the Internet for stations near you.

If you travel around the country on vacation or business you are likely to be close to an EWTN station at least occasionally. Once again you can check the Internet before each trip to see if your itinerary will carry you within range of an EWTN station.

You might also be able to test your interest during the day on a weekend. As mentioned above the AM signal is often ten times as strong before sundown. If you work most of those hours that might not help during the week. But you might well get the station during the day on the weekend which will allow you to test your interest. For example many people in the San Francisco Bay area might be able to get 1620 AM the Sacramento station with a cheap radio during the day. A good shortwave radio or a GE Superadio might bring it in at night.

This idea of trying before you buy must be a preoccupation of mine. I sent a letter to the editor of the New York Times suggesting that oon linebookstores put an excerpt, the table of contents, and the index on their web sites so you could try the book before you buy. Some on the oon linebookstores were already puputting few excerpts before the Times published my letter, but nobody to the best of my knowledge was putting the table of contents and the index oon line A few months or perhaps a year later Amazon.com put up the "Look Inside" system for many of their books. The "Look Inside" system does everything my letter suggested, three different things I suggested were done, coincidence, maybe, maybe not. But back to AM radio.

11. When tuning in weak stations it is important to know exactly where the station is on the dial. You do not want to waste time carefully tuning in the wrong station. If you do not have digital tuning place a bit of invisible tape on the dial so that one side of the tape lines up with where one side of the needle should be when it is tuned into the desired station. If this is too messy for you, you can remember exactly where the needle lines up with any number AM or FM on the dial.

    To find a station you might want to find a place where it comes in well, like outside or next to a window in a tall building, carefully mark where the station is on the dial, and then try again at home.

    It also helps to remember strong stations that are near the station you want on the dial. Strong stations with distinctive programming are useful if you want to explain where a station is to a friend. You can also help friends find radio stations by putting the phone up to the radio so they can hear what it is playing while they try to tune it in. I find this helps them a lot. Helping your friends at church find Catholic stations is a great way to build up the faith and help Catholic radio.

    This last suggestion, and perhaps some of the others may seem a bit trivial, one can see why a book or magazine article might not include them, but space is free on the Internet so I have attempted to include things that might normally be left out so you could try "every trick in the book."

12. Some one sent me an e-mail that said their reception improved when they were close to or touching their radio. Many people have noted this. I used to set my radio on a gallon jar of water

to get a similar effect. Things like this may make reception better or worse. What can I say, experiment.

You can help Catholic radio by spreading information on these and the other tips you will find at various web sites to your fellow parishioners. I demonstrated tips and equipment for the Legion of Mary and my prayer group. If the pastor does not object you might run demonstrations on Sunday morning in front of the church or put some key tips in the Church bulletin.

Here is a web page on Catholic radio stations nation wide,Catholic Radio in U.S.

In this web page I have been discussing AM radio, which is the American term, internationally the term middle wave is used. The tips are also useful for long wave radio.

AM reception links for your home

Here are some links to web pages that contain suggestions that you will not find elsewhere. First some web pages for your home and then some for your car.

I have written a summary of the tips from this page and many other pages. It maybe the most extensive collection of AM radio reception ideas on the web, though some of the other pages go into more depth on certain topics.

A collection of tips based on many web sites

The Pilot of the Airwaves has been a radio hobbyist for many years, and used to work for his college radio station. His page gives the standard advice, which is very important, but also has many other points based on his considerable experience. The pilot's page, like the one you are reading, is on Geocities.com.

The Pilot of the Airwaves

The Australian Broadcast Corporation, ABC, has put up several good pages on AM radio reception. These pages may not cover all the standard material, but they have material the others do not. One of the ABC pages is on troubleshooting at home. This page is currently set up so that you have to move the window from left to right to read it, only for the truly dedicated.

The ABC tips on home trouble shooting

Another ABC page is on home AM antennas. They do not like loop antennas, most other sites do. What they seem to recommend are big outdoor antennas that can be cheap but are difficult to set up and can cause a lighting strike. This page is easily read.

The ABC tips on home AM antennas

Here is another good place to check, because it has a couple of thoughts that other web pages do not, but it is rather short and does not have much of the material that other sites do have. One of his points was that if you have a two pronged plug in which both prongs are the same you might want to try turning the plug over so the prongs go into the opposite slots. He also suggests moving to another plug to eliminate interference that is coming through the plugs. eHow has lots of good practical ideas on many topics. You have to register to get all their advice.

AM radio advice from ehow.com

This web page addresses the issues from a different perspective and might be useful.

Radio Communications Research Unit

Three web sites comparing the GE Superadio with the CCRadio

Here is a careful comparison of the two strongly recommended AM radios.

Comparison of the GE Superadio and the CCRadio

Here is a sophisticated article on the CCRadio which also discusses the GE Superadio. The article tends to support the GE Superadio.

Sophisticated article on the CCRadio and GE Superadio

A popular page on talk radio in Philadelphia that has some material comparing the GE Superadio and Crane's CCRadio.

Philly Talk Radio On Line

Two Web sites on Interference

This is a sophisticated page on AM interference problems. The writer explains what the different sources of interference sound like. This could help you narrow down the suspects as you search for the source of the noise. An advanced page for the person who wants to know all the tricks, but filled with material you will not find on any of the other pages.

Sophisticated AM radio interference page

Another intelligent page on interference. It suggests that many of our interference problems are the fault of the radio or television set.

More wisdom on interference

This web page has a very long list of AM links, many of them intended for AM hobbyists. The page even links to this one, so he must have good taste, right?

Many AM reception and antenna links.

Here is a web site put up by a radio station which may or may not have anything original. Either way it has a good summary of the basics.

AM tips from KVFC

Finally let me mention that you might find material on AM reception by searching for the interational term medium wave radio, more rarely called mediumwave and very rarely middle wave. Conversely if you are searching for information on medium wave you should use advice for AM radio which is the same thing. Long wave radio uses the same techniques as AM radio even though it is on a different part of the radio spectrum.

Links, My Qualifications, and Contact Information

I have a masters degree in Economics and have passed the orals for a Ph.D. I taught economics full time at a large University for several years. I currently do a little freelance writing and have published in *Catholic Digest*, the *New Oxford Review*, and the *Sacramento Bee* among other places.

Have you got any thoughts on improving AM radio reception? Perhaps you know of an important web site that I missed. Why not write about them in my guest book? Geocities will e-mail me to inform me of your entry and only I will be able to read it, so this is like e-mail but I do not get as much spam. I may include your thoughts in this page, which had more than 2,900 hits in June 2004, and perhaps traditionally published works as well.

On Site Radio Pages

- A collection of tips on AM Radio reception from many web sites
- Links for AM reception in cars, trucks, autos
- A new page of links and tips on FM radio reception tips
- A new page on short-wave, also called international band, radio for EWTN
- Timed radio recording
- Sacramento area Catholic radio
- Answers to questions on AM radio reception

Off Site Radio Links

This web site has been honored by a links from

- Immaculate Heart Radio, Catholic radio for Sacramento, Stockton, Fresno, Bakersfield and Reno.
- Sacred Heart Radio, AM-1050, KBLE, Catholic Radio for the Seattle and Puget Sound area

These seven stations, two near Frezno, are almost one third of all the AM stations that carry EWTN and have web sites. In the future I hope that other AM radio stations or networks will link to this site. Why not provide your listeners with the best information on how to bring your station in?

Let me note that Catholic Culture, previously Peter's Net, has given

this web site its highest rating for fidelity to the Catholic faith, so Catholic sites should be able to link to it without fear of being excluded by other Catholic web sites.

Lists of Catholic Radio Stations

- EWTN's list of EWTN stations
- If you use this link you will get a list of EWTN stations, but at the bottom of the page is a link to a second page with a second list of Catholic stations that includes stations that are not EWTN stations. Strangely this second web page has an exact same url as the first one, but you can not get to the second page without going through the first. St Joseph Radio provides a list of Catholic radio stations including some that are not EWTN St. Joseph Radio's web site has an excellent othodoxy rating from Catholic Culture. Perhaps there is some problem with the orthodoxy of non EWTN stations, but in my experience the liberal Catholics simply run music stations. They avoid hot button issues. Other conservative Catholic stations try to be more relevant to the layity but in my limited experience are still orthodox. I do not know that any of these stations is a problem, but if they are, put a note in my guest book.

Some Of My Other Web Pages

Honored Pages

- Famous intellectual, Father Richard Neuhaus recommended my web page on putting Catholic books into public libraries. in his magazine *First Things.* More recently recommended by the National Catholic Register.
- My article on Vouchers which was published in the *New Oxford Review*
- My conversion story published in Catholic Digest, probably the most read English language Catholic periodical.
- A speculative essay on foreshadowing and typology in the Old and New Testament Comments of distinguished professors and Bible experts on typology and foreshadowing, essay.

Practical Pages

- Programing a VCR
- Keeping a fish bowl
- Avoiding spam
- Good, Clean, Free, Internet Comics
- Avoid divorce by choosing well

An Inexcusable Page

My lame attempts at apologetic humor

This page is proudly text only because I value your time. I like to think that my site is information rich and graphics free.

Page last updated July 23, 2004

Home page

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[SITE INDEX]

LOW NOISE RECEIVE-ONLY COAX-LOOP ANTENNAS

for 160 - 10 meters HF bands

Station WN6F listening post

Last Update: 29 March 2004

After doing battle with locally-generated EMI / RFI for nearly two decades, I decided to do something about it. This antenna's main advantage is that it packs a lot of low-angle directivity into a small package. This makes nulling out many urban noise sources easy while enjoying good medium to high-angle skywave reception.

NEW !! (If you are interested in an easier-to-construct wire-only loop that has better performance, check out my general-purpose wire-loop page).

The directional small loop is also useful for significantly reducing static-crashes on the lower HF bands at times; this depends on mother nature of course. The larger loop is for 80 meters and the smaller loop is for 40 meters.

The project is described in four parts:

- General construction and usage (this page)
- Operational analysis of this small loop
- Alternate loop winding methods
- Miscellaneous notes and experiments

They are easy to build, and the only tools you'll need are wire cutters, some coax, and a tuner. You can make them for yourself or friends in a matter of minutes. Part of my design goal was to use a minimum of easily available parts. You won't need a well-stocked junkbox or any exceptional mechanical skills to build this antenna.

Winding the loops out of coax (providing a main antenna loop and an interior coupling loop) in the following fashion is very convenient and has six purposes:

1. The small wavelength outer-conductor loop (at 0.10 or smaller wavelength in circumference) provides the horizontal low-angle bidirectional directivity with deep nulls.

2. The gap in the braid at the top center of the loop allows common-mode reception of signals (both wanted and unwanted) on the outer skin of the loop braid to transition to the inner-skin of the braid. Rotational directivity nulls out the unwanted noise.

3. The current on the inner-skin of the braid now acts like a normal transmission line via the differential-mode to the center conductor.

4. This specially-wound loop acts as it's own balun, which is necessary when using unbalanced coax as the feedline. This helps to ensure that the feedline does not become part of the antenna. If it did, you'd lose much of your directionality, or have very strange nulls.

5. The large amount of distributed capacitance makes the loop somewhat

resistant to unbalance and detuning from hand-body-object capacitance than more traditional balanced wire loops.

6. The larger outer conductor diameter of the braid increases the sensitivity of the loop over that of a small-gauge wire.

Prove it!: Attach a clamp-on ferrite RF cable choke on the feedline and arms of the loop. When chokes are placed anywhere on the arms of the split-braid loop, severe detuning and attenuation takes place. When placed anywhere on the feedline after the loop output, no detuning or attenuation occurs.

HF loops built in this way are typically used for direct wave direction-finding. I'm more interested in using them as near-field noise-nullers to enhance the signal-to-noise ratio of skywave signals. This helps make up for their inherently lower gain than more traditional long wire antennas. A balun-effect is created by the way we wind the antenna back onto the feedline to help prevent common-mode noise ingress and maintain an accurate directional pattern.

2004 update: See below for smaller TWO-TURN Loops!

I'm using these antennas indoors right next to the operating position to make it easy to rotate and tune. Remote mounting is certainly possible, preferably with an antenna tuner or preamp located near the loop, although in that case I'd advise using a plain wire loop if you want to keep the tuner near the operating position.

As an example, let's build a single-turn 0.10 wavelength loop for 40 meters: (it will also function well as a .05 wavelength loop on 80m with retuning)

WHAT YOU'LL NEED:

- For 40 meters, you'll need about 15 feet of coax (loop and some extra length for tuner connection, plus pigtail wrap.) I prefer to use 50-ohm RG-58. For convenience I picked up a 50-foot jumper at Radio Shack (#278-971A) which is already connectorized so I could build a few of them. You could also use 75-

ohm coax without any difficulty. Try to get the lowest capacitance cable that you can find.

- An antenna tuner can be used to tune the loop system to resonance. I've used L-type tuners and T-type tuners without any problems. I'm currently using an MFJ-16010 random-wire tuners which are small and use two SO-239 connectors which makes them easy to hook up and mount to a mast if desired. Note that on 160 meters, you'll need a lot of inductance, and the 16010 model doesn't seem to have enough when used with coax-loops.

- Optional: A 10 dB gain or more preamp can be used to help bring up the signal level. If your receiver has a preamp, and all it seems to do is bring up the noise level along with the signals, you are in for a treat. With this directional antenna, the preamp finally becomes useful in amplifying the signals, and not the noise.

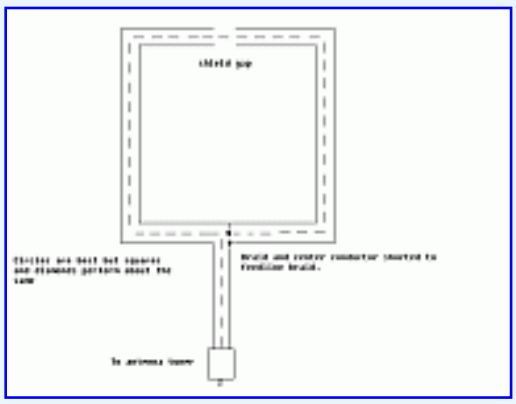
Use the largest coax diameter you find practical. I use RG-58 since it is easier to work with, but the larger conductor size of RG-8 / 11 should perform a little bit better.

LOOP SCHEMATICS:

My best artistic attempts at drawing the schematics.

Click on the images for a larger picture.

(Internet-Explorer users: IE has an option that automatically reduces the size of graphics. If the enlarged schematics look distorted, be sure to view them full-size, typically with F11 Key)



HOW TO MAKE IT:

(Click on any of the images to enlarge them.)

1) First, at one end of the coax, let's short the braid and center conductor together with a pigtail. RG-8 was used to make it easier to see, although I like to use the smaller RG-58 or RG-6. After removing the outer covering, I bunched the braid back a bit to allow me to cut into the inner dielectric and then just pushed it back down when I was done. Take care not to cut or score the inner conductor with the knife, especially when using the smaller cables; when you wrap the pigtail around the braid in a later step, it has a tendency to snap at the cut or score when you wrap it.

(It might be easier to build the loop by following these instructions backwards if you already have a connectorized piece of cable.)

2) We need to create a 1-inch gap in the coax shield. Measure 7 feet from the shorted end, and make a small cut mark on the coax. A half inch on either side of the mark, cut through the outer covering exposing the braid. Then cut the braid out to expose just the inner dielectric. Try not to cut into the inner dielectric as this will mechanically weaken the antenna when you eventually mount it. The photos show some exposed braid at the gap just for clarity, but my antennas just have a clean cut. Note that this is just a true gap, you do not short anything at the gap! (Make sure there aren't any fine strands of shield wire still connected across the gap after you cut it!)

KEY POINT: The gap allows common-mode reception of radiated energy (both wanted and unwanted) on the outer braid skin to transition to differential-mode currents on the inner braid skin, which is coupled to the center conductor via differential-mode. Rotation nulls the unwanted common-mode energy exposed to the arms of the loop.

3) Measure another 7 feet from the center of the gap, and remove about 1 inch of the outer coax covering ONLY. You should just have some exposed braid.

4) Take the shorted pigtail end of the coax, and wrap it around the exposed braid from the previous step. This is the weakest point of the loop mechanically. Try not to make a radical bend at the point where the brittle center conductor is immediately shorted to the braid; it has a tendency to break if you do. Wrap at a point just a little bit further down the pigtail to avoid breaking the center conductor.

KEY POINT: This finishes the self-forming balun and helps ensure that the unbalanced feedline does not become part of the balanced loop, thereby unbalancing it, and turning the loop into a noisy random wire.

(NOTE: don't be tempted to use an ordinary "tee" connector here. It won't work properly.)

You now have a highly directional low-band 40 meter loop and the rest is a small length of feedline that goes to the input of a tuner. Of course the jumper from the tuner output to the receiver can be any convenient length.

For 160 through 40 meter operation, you can mount the tuner anywhere from 6-inches to 6-feet away from the output of the loop. This allows you some flexibility if you want to keep the tuner on the desk and not on the mast. For smaller single-turn loops on 20 meters and above, try to keep the tuner no more than 6-inches away from the loop output - the closer to the loop output the better.

Note: Here is a very small loop for overall visual reference.

To construct a 20 meter loop, try a loop circumference of 7 feet. The gap is not critical for any band, and can stay at 1 inch. For 80 meters, try a loop circumference length of 27 feet or so. For 20 - 15 meters, try a 3-foot circumference; I'm amazed that this actually works as well as it does.

Note that when we cut loops for 0.10 wavelength, they will also perform well at half their frequency as a 0.05 wavelength, although sensitivity will be down somewhat. The positive tradeoff is that the nulls will be VERY deep at 0.05 wavelength.

Design Your Own!

UPDATE: MAJOR ERROR IN MY EARLIER DESIGNS!

My apologies go to earlier readers of these pages. I incorrectly assumed that since we are using coax as antenna elements, that they would be subject to a cable's velocity factor. Since the loop element is really the outer braid skin, **it is not subject to velocity factor.** Only the inner differential-mode of coax is subject to velocity factor, and NOT the common-mode outer surface conductor of the braid, which is what we are using as the antenna!

My standard formula for calculating the loop circumference for the frequency of interest at 1/10th wavelength *without any VF*, is:

(1005 / freq mHz) * 0.10

TUNING NOTES

This formula should get you in the ballpark, although if you can't get a definite peak with your tuner on the lowest frequency of interest, it is likely that the antenna is too long, or the distributed capacitance of the cable used is too high for your tuner to handle. Try using a more advanced tuner, or reduce the loop circumference length.

You can cut a new loop with a cable that has lower capacitance specs, or just make the existing one shorter. Fortunately it is easy to make a pre-cut loop shorter. Let's cut off two feet from the existing loop circumference as an example:

- Unwrap the shorted pigtail from around the exposed braid. Cut away a foot from this arm of the loop and create another shorted pigtail.
- Measure a foot from the center of the old exposed braid, and cut a new 1-inch exposure of braid.

- Wrap the new pigtail around the new exposed braid section and re-shape the antenna into the smaller shape. Tape up or heat-shrink the older exposed braid section.

- Try to be as accurate as possible and strive for balance when re-sizing the loop. Balance is important!

USAGE:

You can create the loop with any shape you want, but circles are best, and squares and diamonds do nearly as well. Triangles, and extreme rectangles don't do as well, but don't let that stop you. The key is to enclose as much area as possible. For mounting, any sort of cross-brace should work, but I've also placed them on the back of non-metallic doors, hung them from ceilings, etc.

Tune the loop-system (loop and feedline) to resonance with the tuner. Since loops are high-q, you should hear a definite peak in the background noise. Better yet, tune to some locally-generated noise and peak on that. As you change each setting of the inductor, rotate the tuner capacitor(s) s-l-o-w-l-y.

The directivity pattern is a bidirectional figure-8 pattern at low angles, with maximum gain in the plane of the loop, and the nulls are broadside to it. It is just the **opposite** of an ordinary dipole. The loop seems progressively more omnidirectional to medium and high skywave angles.

If you want to see the directional azimuth and elevation angles, check out my general-purpose wire-loop page. The patterns are almost exactly the same as compared to these coax-built loops.

You don't have to have the loop perfectly vertical, use whatever angle you need to null the local noise or storm-related static crashes - skywave signals will still be heard well. In one case, I have a noisemaker downstairs, so I had to rotate and tilt the loop at about 45 degrees to null it - it didn't attenuate the desired band signals at all. At times I've been able to track a storm all night and reduce the static crashes, and then sometimes not depending upon how localized the storm is.

You might notice that even though you've nulled out the noise, signal levels on a tuned loop seem to be about 2-to-3 S-units down from a standard 1/2-wave dipole mounted up at least a quarter-wave above ground. This is normal for a *tuned* small

loop given its short wavelength. You can compensate with a preamp, but you might find that with the noise level so low, you won't need one. If your normal antenna isn't mounted up at least a quarter-wavelength, the comparative loss might be even less!

Note: many modern radios that have built-in selectable preamps might have much lower sensitivity with the preamps off than other radios that don't have any preamps at all. This is a good design feature. Accordingly, with radios that have selectable preamps, it is likely you'll want to run with at least the first preamp turned ON.

The important point to remember is that your noise floor will be so much lower than your old noisy antenna that it more than makes up for brute signal strength.

Connector Quality Issues

Make sure your connections are snug. If you lose the ground, you'll end up with a random-wire because you've lost the electrical balance. I mention this because as you insert or remove the connector from the tuner or receiver, when only the center-conductor is making a connection, you'll hear noise or signal level come up a bit. Unfortunately, you will have lost all the directivity that this antenna provides. Keep those connections tight.

A caution about crimped PL-259 connectors: sometimes the crimp is so tight that when you screw them fully into the chassis jacks, they don't actually make good contact with the chassis-connector center conductor. A **VERY GENTLE** squeeze with a pair of pliers on the center-conductor pin will help ensure good physical contact. I've run into this problem a lot with cheaper cables and sometimes it is not immediately apparent because you can still receive signals (poorly) due to capacitive coupling of the center pins.

Another drawback of cheaper connectors is that when you mate the dielectrics of the cable plug and chassis jack together, they sometimes don't allow the shells to make contact, especially if the "teeth" are short. You might only have a very poor shell-to-chassis connection via the rubbing of the cable's screw ring to the shell.

TWO-TURN LOOPS!

To turn a large loop into something more manageable size-wise, try a continuous TWO-TURN loop. Each turn should have a 1-inch gap at the top of the turn, and at the bottom of the turn you attach the exposed braids and shorted pigtail together.

Turn spacing: you might want to put a coax-diameter's width of space between the two turns. I did this by winding one turn on the front of the mast and the other turn on the back.

(Click on any image to enlarge)

For example, my 40 meter single-turn diamond loop has a 14-foot circumference with an approximate 4-foot diameter.

I turned it into a two-turn loop by starting with a new 14-foot length of coax, and depth-winding a second continuous turn around a 2-foot circular diameter instead of a square 4-foot diameter. At the top of the loop are my two turns with the 1-inch gaps at the center. At the bottom output of the loop I made sure the exposed braids and shorted pigtail are connected together. From this point, I left about 6 inches of coax terminated with a PL-259 connector which attaches to my portable MFJ-16010 tuner.

(Note: I recently placed the tuner on the desk with a 3 foot jumper instead since this loop was designed for the lower bands. For smaller single-turn loops designed for 20 meters or higher, the length of feed from the output of the loop to the tuner should not exceed 6 inches - the closer to the output the better.)

Try to make all your measurements, cuts, and braid connections as symetrical as possible. Making the loop balanced is key to good noise rejection.

Here is how I made it:

- I used a 15 foot length of coax to allow for a short 6-inch run to the tuner and

some left over to make the shorted pigtail.

- Six inches from the end of the connector, make a 1-inch cut around the coax to expose only the braid.
- Measure 3.5 feet from the center of the exposed braid, and cut a 1-inch gap (1/2 inch on both sides of the mark) through the braid to expose the dielectric.
- Measure 3.5 feet from the center of the exposed dielectric, and cut around the coax for 1 inch to expose only the braid. (1/2 inch on both sides of the mark.)
- Measure 3.5 feet from the center of the exposed braid, and cut a 1-inch gap (1/2 inch on both sides of the mark) through the braid to expose the dielectric.
- Measure 3.5 feet from the center of the exposed braid, and short the shield to the center conductor. Leave about 4 extra inches or so of this shorted pigtail.
- Wrap the coax into a two-turn loop with the exposed braids parallel to each other at the bottom, and the exposed dielectric gaps at the top. Use tie-wraps, tape, etc.
- Wrap the shorted pigtail around the centers of the exposed braid sections at the bottom so that all the braids are in contact. Solder or tape together.
- Put the loop on your support, attach your tuner to the connectorized end and enjoy!

The results of this two-turn loop are great! Signal output levels between my single and reduced-area double-turn loops seems about the same.

Casual MF BCB DX'ing and LF

If you bypass the tuner, you might be able to use a loop cut for 80 or 160 meters in an untuned mode for casual MF BCB and LF reception. It is handy to null out the local broadcasters.

With the loop untuned, I've finally heard low-frequency CW beacons. So there IS life down there! For serious use, I'd definitely recommend specialized antennas for these bands, but at least an untuned loop might whet your appetite to go "lowdown".

Other Sources of Info

I am indebted to all the Amateur Radio operators, SWL's, BCB DX'ers, VLF'ers and other experimenters that provide me with information and encouragement with this project. They participate in the **Yahoo!® Loop group** and also on the **rec.radio.amateur.antenna** newsgroup. All errors and misinterpretations belong to me however ...

If you're interested in loops, whether they be shielded, unshielded, magnetic, loopsticks, etc, you can find a great discussion forum for loop antennas on Yahoo!® by clicking here.

Be sure to visit the K7ZB site with his pics and nice build of this loop, along with other interesting antenna solutions.

- General construction and usage (this page)
- Operational analysis of this small loop
- Alternate loop winding methods
- Miscellaneous notes and experiments
- Easy-To-Build Small Wire Loops!

since 1 June 2003

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The VE7SL Radio Notebook

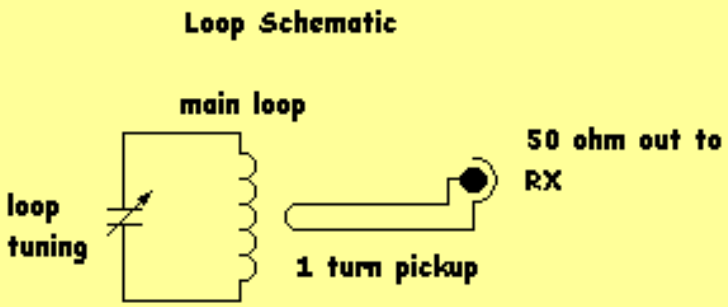
A 10' RECEIVING LOOP FOR LOW-FREQUENCY DX WORK

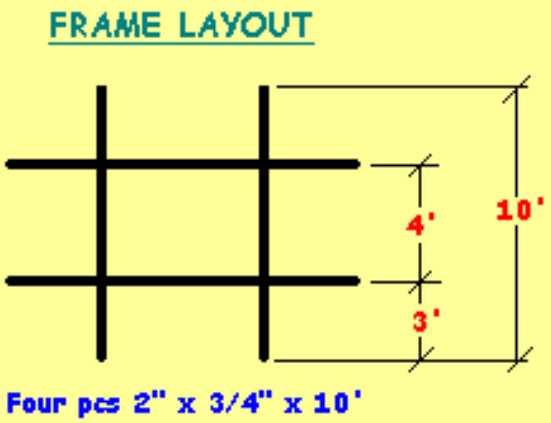
(P. 2 - A BROADBAND SHIELDED LOOP FOR LF)

My ten foot air-core receiving loop was originally designed and constructed for NDB DXing. More recently, it has been pressed into service for LOWFER DX work. The loop has been instrumental in achieving two notable low-frequency receptions - the first Trans-Pacific reception of ZL (New Zealand) amateur radio signals in North America as well as establishing the present long-distance record for LOWFER reception in North America, the 1-watt signal of "NC" from North Carolina to British Columbia, an overland distance of 2,360 miles. The loop is a good performer!

OVERVIEW Basically the loop is like most antennas, just a big resonant tuned circuit probe that is coupling into the radio signal's electromagnetic field. Electrically, the loop

looks like the tuned circuit shown here. The 1-turn link couples signals out of the main loop to be fed to the receiver. The loop is tuned (signals peaked) with the variable tuning capacitor. The frequency tuning range of the loop basically depends on the number of turns in the main coil and the size of the tuning capacitor. My ten-foot loop has 14 turns of #20 plastic coated stranded copper wire. The tuning capacitor is a 400pf dual variable with both sections connected in parallel. The tuning range of the loop is from 180kHz to 410kHz approximately. By adding a 250pf silver mica fixed capacitor in parallel with the loop, tuning will drop to around 135kHz at the low end, perfect for the new 136kHz band when it arrives. Conversely, by shorting out the first turn in the loop, the lower end of the broadcast band can be tuned. Reducing the number of turns will raise the overall frequency tuning range. For the BCB DXer, I would suggest reducing the number of turns to 8 or 9. Going with even fewer turns, the loop would make a great low-noise, directional 160m receiving antenna.





CONSTRUCTION- The loop frame is built from 2 x 3/4 Western Red Cedar. Redwood, Yellow Cedar or even marine-grade plywood should serve equally well. Perhaps you have something similar, indigenous to your area that could be procurred. The frame must be strong and weather resistant and of course the lighter you can make it, the better. The frame must not be metallic! The four legs of the frame are all 10 feet in length. At each crossover point, a half-lap joint has been cut to join the frame together. Each joint has been screwed with a single brass wood screw and glued with two-part exterior water-proof glue. The loop has been outdoors for about 4 years now and has survived several dozen severe windstorms coming directly off the ocean. Part of it's "survivability" is due to the flexibility of it's 2" plastic ABS support mast. This allows the mast to absorb the brunt of the wind blasts. There have been several storms where the loop has been bent-over at a 30

degree angle for long periods yet it continues to survive, so far!

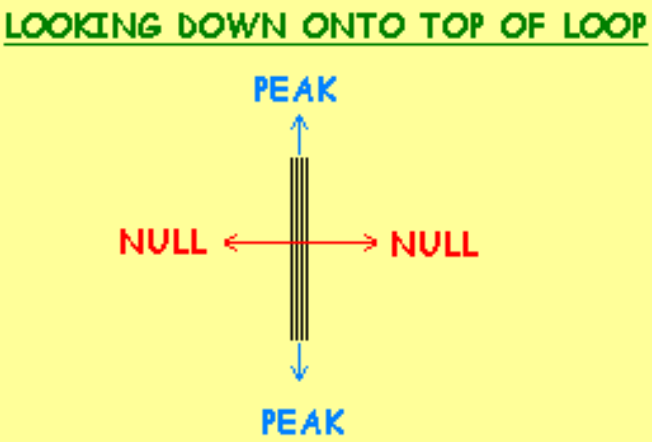
Attached to the end of each frame leg is a wooden "wire-comb" that is used to keep the loop wires in alignment. The spacing between each wire will determine the length of the comb. The wider the spacing, the better, but a point is quickly reached where the spacing makes the loop windings too "floppy". Each turn of my loop is spaced .25 inches apart. The wooden combs are 1.5" X 5" and have been glued and dowelled into a groove cut in the end of each frame leg. They could just as effectively be glued and screwed to the outside ends of all legs. In order to effectively capture each coil winding, the combs were drilled with the correct number of holes and then the top part of the comb was cut off, leaving the bottom half of each hole to act as a groove to capture and hold the wire.

Once the loop was wound, a heavy coating of the same two-part waterproof glue used earlier was liberally applied over the wires where they lay on the combs, anchoring them firmly in place.

The pickup loop (fed to the receiver via 50 ohm coaxial cable) is a 1-turn loop wound around the inside of the main loop. It is spaced approximately 6" inside the main winding. Wider spacing will result in reduced signal pickup as well as sharper tuning, necessitating frequent re-peaking. An advantage of the single turn pickup loop is that the loop is completely electrically isolated from the main station ground, often a source of induced noise pickup. In it's present configuration, it is only necessary to re-peak the tuning capacitor every 50KHz approximately. When DXing the NDB band (200-530KHz) it can often take an hour or more to carefully tune through the chosen 50KHz segment before re-tuning for the next range. If used for LOWFER DX work, it is simply a matter of 'set and forget' tuning!

PERFORMANCE **As outlined earlier, the ten-foot loop has proven to be a good performer right from the start. Preamplifiers are often used with small homebrew loops to compensate for their low level of signal pick-up. The large aperture of this loop provides more than enough signal pick-up. No preamplification is used or required. Preamp-induced overload or cross-mod problems caused by nearby "blowtorch" signals are non-existent. The limiting factor of reception is always local or (more often than not) atmospheric noise, easily reached with the large aperture.**

In an electrically noisy location, the loop can often be used to best advantage as a steerable "null" to eliminate or vastly reduce the noise source. In quiet locations, the loop can be turned to enhance signal pick-up. Maximum signal pick-up is in the plane of the loop. For more information on loop antennas, see the links section below and ....good looping!



Steve (VE7SL)

LOOP LINKS

RECEIVING LOOP AERIALS FOR 1.8MHZ (VK5BR) *- Plans for 160m RX loop and preamp*

A.M. LOOP ANTENNAS *- Construction info for several AM BCB loops*

LOOP ANTENNAS *- Almost everything you ever wanted to know about loops!*

THE LOW FREQUENCY RECEIVING LOOP *- A 6' air - core loop for the LOWFER band*

SUPERLOOP RECEIVING ANTENNA FOR 136KHz *- A nice air - core loop from G3LDO*

THINKING ABOUT IDEAL LOOPS *- A detailed discussion of loop dynamics*

DOUG'S RADIO-ELECTRONICS LOOP ANTENNA PAGE *-Various loop characteristics*

THE OCTOLOOP *- An LF loop by Lowfer N4YWK*

160 / 80m COAXIAL RECEIVING LOOPS *- Practical construction data*

LISTENING FOR LOWFERS *- Constructing an 8' air - core loop for LF*

YAHOO! 'LOOPS' DISCUSSION GROUP *- Talk with others about all kinds of loops!*

HOME

Der Bau einer Rahmenantenne

Eigentlich, - ursprünglich, wollte ich ja diese Bauanleitung zu einem Bestandteil des vorherigen Artikels, des Super-Het-Empfängers, geschrieben haben. Die Gründe waren weil er a) sehr gute Empfangseigenschaften - speziell für den Superhet bot und b) in der Superhet-Schaltung, im Audion-Eingangskreis, diese Rahmenantenne schon eingeplant wurde (siehe die Super-Het-Schaltung, am Eingangskreis wird die Antennenspule L1 und L2 komplett durch den 2 x 2-poligen Schalter R abgeschaltet, die Rahmenantenne übernimmt die Funktion dieses Kreises).
Weil diese Rahmenantenne sich aber auch hervorragend für praktisch alle anderen Radio-Empfänger anbietet, entschloß ich mich, sie als separaten Bauvorschlag vorzustellen.

Eine Rahmenantenne wirkt in den den Sommermonaten störungsfreier als eine Außen- oder Hochantenne, der Empfang mit ihr ist bedeutend selektiver als mit einer Hochantenne.
- Je kleiner die Antenne, bzw. die Antennen-Kapazität, desto größer ist die Abstimmschärfe.

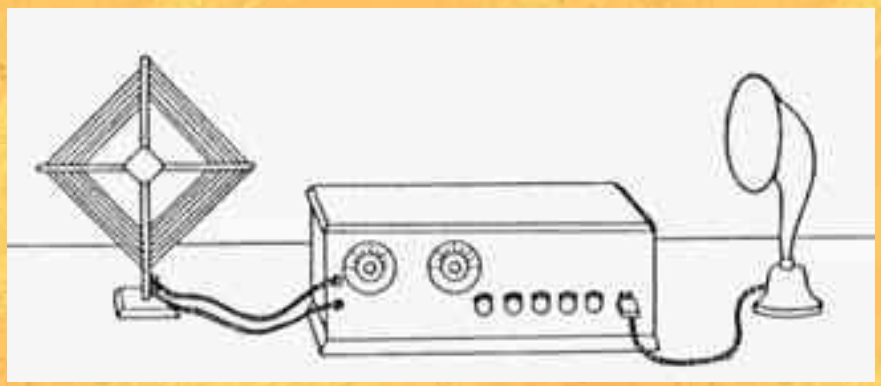
Für diese Antenne wird ein quadratischer Holzrahmen mit 1 Meter Seitenlänge sowie 20 cm Rahmenbreite angefertigt - am besten geeignet ist Buchenholz. Dieser Rahmen wird mit 8 Windungen 1 mm dicker Antennenlitze bewickelt, im Windungs-Abstand von jeweils 0,5 cm. (Eine Zeichnung dieses Rahmens anzufertigen halte ich nicht für notwendig.. - ich denke, jeder kann sich vorstellen wie dieser Holzrahmen aussehen muß)

Je mehr Einzel-Litzen die Antennenlitze - HF-Litze, wie das "Rupalit" der Firma Pack Feindrähte - enthält, desto besser! - Ideal ist die Rupalit-HF-Litze mit 270 Einzeldrähten, 2-fach Seide umsponnen, mit einem größten Außendurchmesser von 1,1 mm, bei der der Einzeldraht - der natürlich

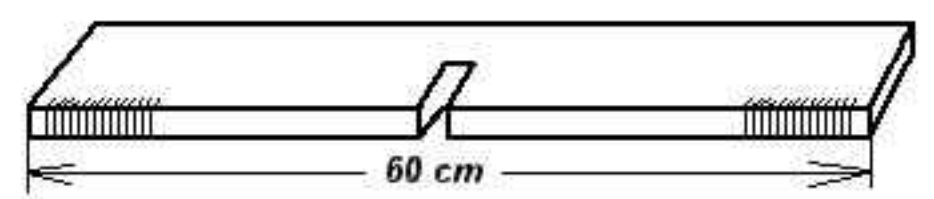
auch durch Lackierung noch einmal einzeln isoliert ist - einen Durchmesser von 0,04 mm besitzt. Eine 1 KG-Rolle hat hierbei eine Lauflänge von ca. 250 Meter.
- Ich bin in Kontakt mit einem Vereinsfreund, der sich bereit erklärte in absehbarer Zeit - ja nach Bestellung - Vorräte bestimmter Drahtstärken und -farben anzulegen und sie dann, je nach Bedarf (und Bestellung) in auch kleinen Mengen zu verkaufen.
Da ja für diese Antenne, bei einer Kantenlänge von 1 m sowie bei nur 8 Windungen eine Drahtlänge von 32 Metern ergibt, wäre diese Möglichkeit sicherlich - für den einen oder anderen alleine hierbei schon - hochinteressant - denn wohin sonst mit den restlichen ca. 220 Metern...

Eine Kombination aus Rahmen-Antenne ***und*** einer Antenne läßt sich erreichen wenn man in diesen Rahmen noch einen weiteren, inneren Rahmen gleicher Breite einsetzt, der mit etwa 2 - 5 Windungen - gleicher Draht, gleiche Wickelrichtung - bewickelt wird. Anfang und Ende dieser Wicklung wird mit der Hoch- oder Außenantenne bzw. der Erde verbunden.

Eine weitere Variante einer Rahmenantenne zeigt die Skizze eines frühen Empfängers mit Trichterlautsprecher und Rahmenantenne.



Eine solche Antenne wird mit zwei Holzstäben, 2 x 2 cm Querschnitt, hergestellt. Einer der beiden Stäbe ist 60 cm, der andere 65 cm lang. Die beiden Holzleisten aus Buche, beide in der Mitte - wie im Bild zu sehen - mit einer Nute in der Mitte.

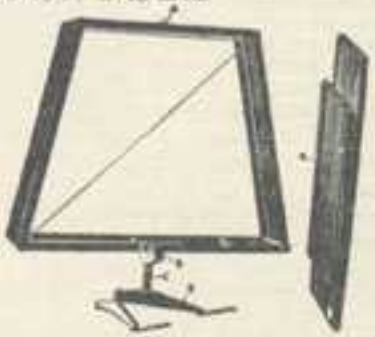


Damit werden die beiden Holzleisten zu einem Kreuz zusammengesteckt, die überstehenden Enden des einen Stabes dienen dazu, das Kreuz auf einem Bodenteil - wie bei einem Christbaumständer - zu befestigen.
Es werden 15 Windungen 1-mm-HF-Litze (s.oben) spiralförmig von außen nach innen in das Kreuz hinein gewickelt. - Die Drahtbefestigungen können z.B. aus Messingnägeln bestehen, oder auch aus kleinen, mit einer feinen Säge hergestellten Einschnitten, wie sie im Bild angedeutet sind.
Der Abstand zwischen den einzelnen Nägeln (oder Einschnitten) - und damit zwischen den einzelnen Drähten - sollte jeweils 1 cm betragen.
Diese so hergestellte Antenne ist optimiert für den Empfang des Wellenbereiches von 200 - 700 m, sie deckt also den gesamten Mittelwellenbereich ab.
Die beiden Ableitungen der Antenne werden dann in der üblichen Weise mit dem Empfänger verbunden - 1 Anschluß an den Antennen-Eingang, das zweite Ende wird mit der Erde verbunden.

Zum Abschluß zeige ich noch 2 Seiten aus einer Werbung aus der Zeit um 1928 - hier wird für Rahmenantennen geworben. - Man erkennt die vielfältigen Formen, wie eine solche Antenne aussehen kann und wie sie damals hergestellt und gekauft wurden...

RINKEL-KLAPPRAHMEN-ANTENNEN

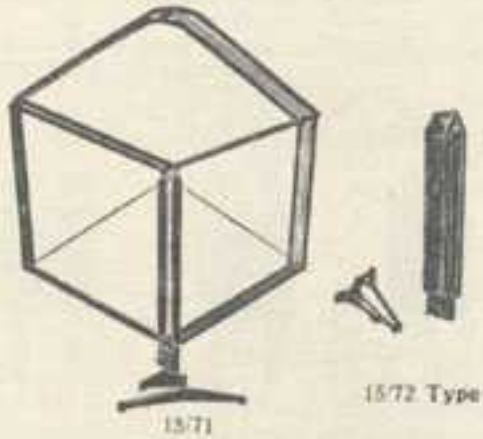
D. R. P. D. R. G. M.



15/70

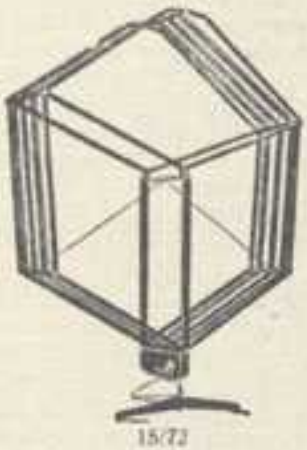
Mit einem Griff geöffnet oder geschlossen. Drähte bleiben in allen Stellungen, auch in geschlossenem Zustand gleichmäßig straff gespannt!

15/70 **Type TR 62**
Windungsfläche = 0,25 m², Wellenbereich = 220 bis 645 m, mit Verlängerungsspule beliebig zu erhöhen. Größe zusammengeklappt: 62×17,5×4 cm.
b) mit exaktem Mittelabgriff.



15/71

15/71 **Type KR 63.**
Windungsfläche = ½ m², Wellenbereich = 170 bis 950 m, mit Verlängerungsspule beliebig zu erhöhen. Größe zusammengeklappt: 63×14,5×7 cm.

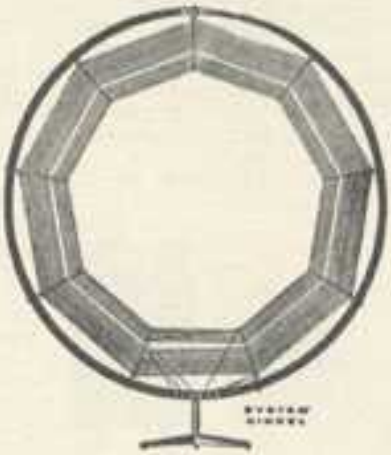


15/72

15/72 **Type KRL 63.**
Mit einem Schaltergriff umschaltbar für Rundfunk- und Langwellen. Höchster Wirkungsgrad, da stets sämtliche Windungen in Betrieb und niemals tote Windungen vorhanden.
Windungsfläche = ½ m², Wellenbereich lückenlos 240 bis 1770 m. Größe zusammengeklappt: 64,5×22,5×7 cm.
b) mit exaktem Mittelabgriff.

15/73 **Rinkel - Rahmenschnur Type S 2,**
für alle Rahmen-Antennen, kapazitätsarm, hochflexibel, Länge 1 m.
a) 2-adrig, b) 3-adrig.

15/65



15/67

15/66

15/64 **Heliogen - Universal - Außenantenne,** stabile wetterfeste Ausführung. Vorteile: Arbeitet störungsfreier als jede Hochantenne. Einfache Montage in wenigen Minuten. Erfordert nur einen Mast zur Aufstellung. Beansprucht keine Nachbar-Grundstücke. Vermeidet das Ueberqueren von Starkstrom- und Telephonleitungen. Größte Kapazität, keine Richtwirkung. Als Außen- als auch Zimmerantenne verwendbar. Besonders vorteilhaft für Grundstücke mit mehreren Empfangsanlagen. Auch für kurze Wellen geeignet. Transportabel.

15/65 **Vogel-Rahmenantenne,** Type FR. 64.

15/66 **Vogel-Klapprahmen,** Type FKL. 96.

15/67 **Vogel-Universal-Rahmen,** Type FRL. 88.

15/68 **Vogel-Antenne „Ema".**

15/69 **Vogel - Universal - Rahmenschnur,** System Rinkel. — Type SS 12, D.R.G.M. Die Vogel - Universal - Rahmenschnur besteht aus einem Spezial-Steckumschalter in Verbindung mit der kapazitätsfreien „Vogel-Rahmenschnur". Mit Hilfe dieses Zusatzes geschieht die Umschaltung vom kurzen auf den langen Wellenbereich durch einfaches Versetzen der Schaltleiste. Der Steckschalter wird dabei stets auf der Vorderseite des Rahmens (Köpfe der Anschlußbuchsen) eingesteckt.

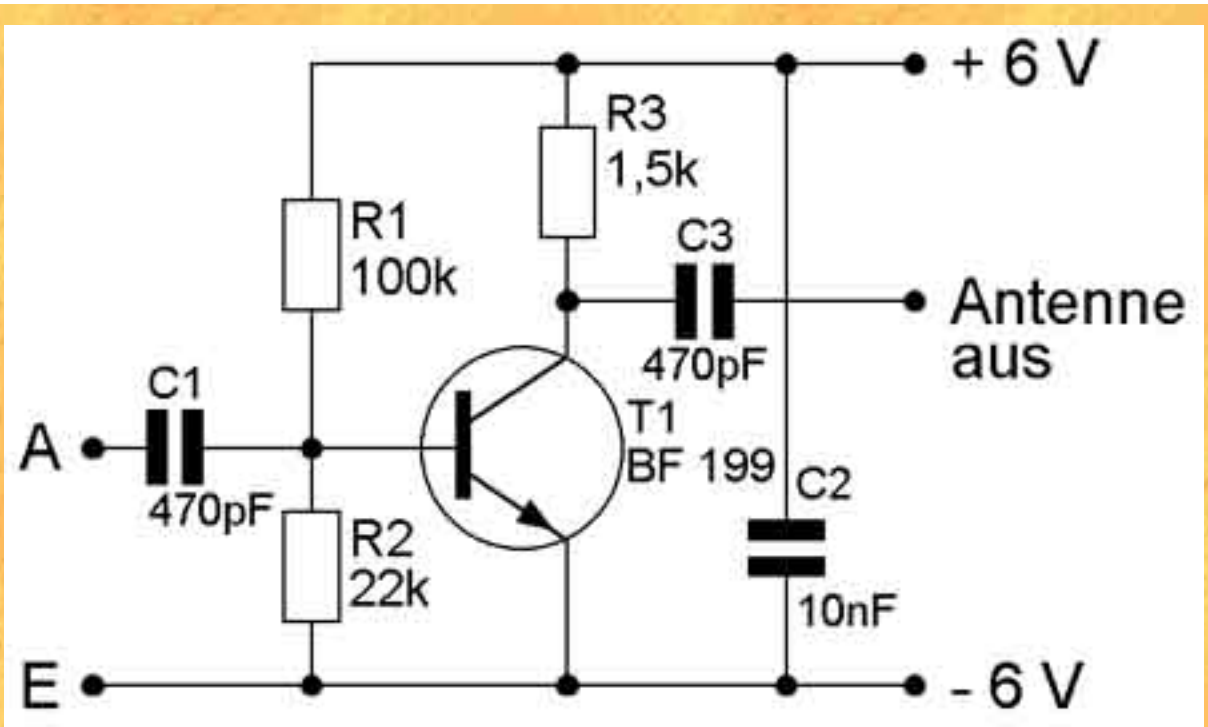
15/69

5/68

Ausgehend von einigen neuen Erkenntnissen möchte ich nun diese Seite erweitern. - Zunächst noch eimal etwas zur Funktion.
Die Rahmenantenne stellt eine Flachspule mit sehr großem Durchmesser dar, die unmittelbar aus dem elektromagnetischen Feld des Raumes Energie aufnimmt. Da die induzierte Spannung am größten ist, wenn die Spule senkrecht von den magnetischen Kraftlinien durchsetzt wird, so besitzt sie eine Richtwirkung.

Die für eine Rahmenantenne erforderliche Windungszahl n ist von der Seitenlänge s abhängig und beträgt für den Mittelwellenbereich :
bei s = 20 cm . . n = 19
s = 25 cm . . n = 14
s = 40 cm . . n = 10 Windungen
Für den Langwellenbereich ist etwa die vierfache Windungszahl erforderlich.
Hinweis: Da eine Rahmenantenne eine Spule darstellt, gilt hierbei keinesfalls: je länger der Draht - desto mehr Antennenenergie!
Um festzustellen ob die räumlichen Verhältnisse den Aufbau einer Rahmenantenne überhaupt sinnvoll macht (es sind die elektromagnetischen Sendeenergien, die man hiermit empfängt!), sollte man sich vorher mit einer Ferritantenne kundig machen.
Hierzu wird ein etwa 15 - 20 cm langer Ferritstab, ca. 10 mm Durchmesser, benötigt. Diesen bewickelt man, eng Windung an Windung, mit 50 Windungen HF-Litze. Ein Ende der Wicklung wird am Antenneneingang des Empfängers - beispielsweise ein Detektorgerät - angeschlossen, das andere Ende der Wicklung amErdanschluß. Diese Antenne hat die gleichen Eigenschaften - auch in Hinsicht auf Qualität und Stärke der empfangenen Sender - wie eine Rahmenantenne.

Hat man jedoch keine Möglichkeit eine Rahmen- oder Ferritantenne verwenden zu können, beispielsweise wenn der Raum in dem der Empfänger mit zu viel Eisen(beton) abgeschirmt ist, so hilft eine Langdrahtantenne. - Bitte, weiterlesen!
Ich meine eine künstliche Langdrahtantenne...
Man besorgt sich einen Transistor und die paar externen Bauteile und lötet sie wie die hier vorgestellte Schaltung zusammen:



Quellennachweis dieser Schaltung: Funkgeschichte Nr. 55, S. 11. Schaltung nach Lörtsch, Detektorempfang mit einer 2 m langen Antenne.

Ein Freund von mir baute diese Schaltung auf einem 1 DM großen Lochrasterplatinenstück auf. Die fertige Schaltung wurde dann mit einer Heißklebepistole auf dem Anschlußclip einer 9-Volt-Batterie befestigt. Ein 2 Meter langes Drahtstück - am Antenneneingang der Schaltung angelötet - wird somit zu einer 20 Meter langen Langdrahtantenne. Mein Freund, dessen Bastel- und Heizungskellerraum identisch sind, der von dickem Eisenbeton umgeben ist und mit einer Ferritantenne keinerlei Empfang hat, kann mit dieser künstlichen Langdrahtantenne sogar bestens seine Detektorgeräte "befeuern" . .

Viel Spass beim Nachbau !

Zurück zur Hauptseite

A Universal LF/MF Preamplifier

By Lyle Koehler, KØLR

Perhaps calling this a "universal" preamp is stretching things a little, but it works on the LF and MF bands with loop, whip or random-length wire antennas. Regeneration can be used with any type of antenna, although the circuit provides very high gain even without it. Because of its versatility, this preamp is ideal for experimenting with various types of receiving antennas. This article also shows how the preamp can be powered and tuned remotely, with only a single coax line between the remote antenna site and the receiver.

The Circuit

The universal preamp design is shown in Figure 1. It fits on a Radio Shack No. 276-150 general-purpose IC board with room to spare. Layout isn't especially critical; just follow the usual rules of RF circuit construction. Keep all leads as short as possible, and allow a respectable distance between the input and output leads. The preamp should be enclosed in a metal box to provide shielding. Tuning and regeneration control components are shown enclosed in dotted lines. Later in this article I'll show how these circuits can be modified to allow remote operation.

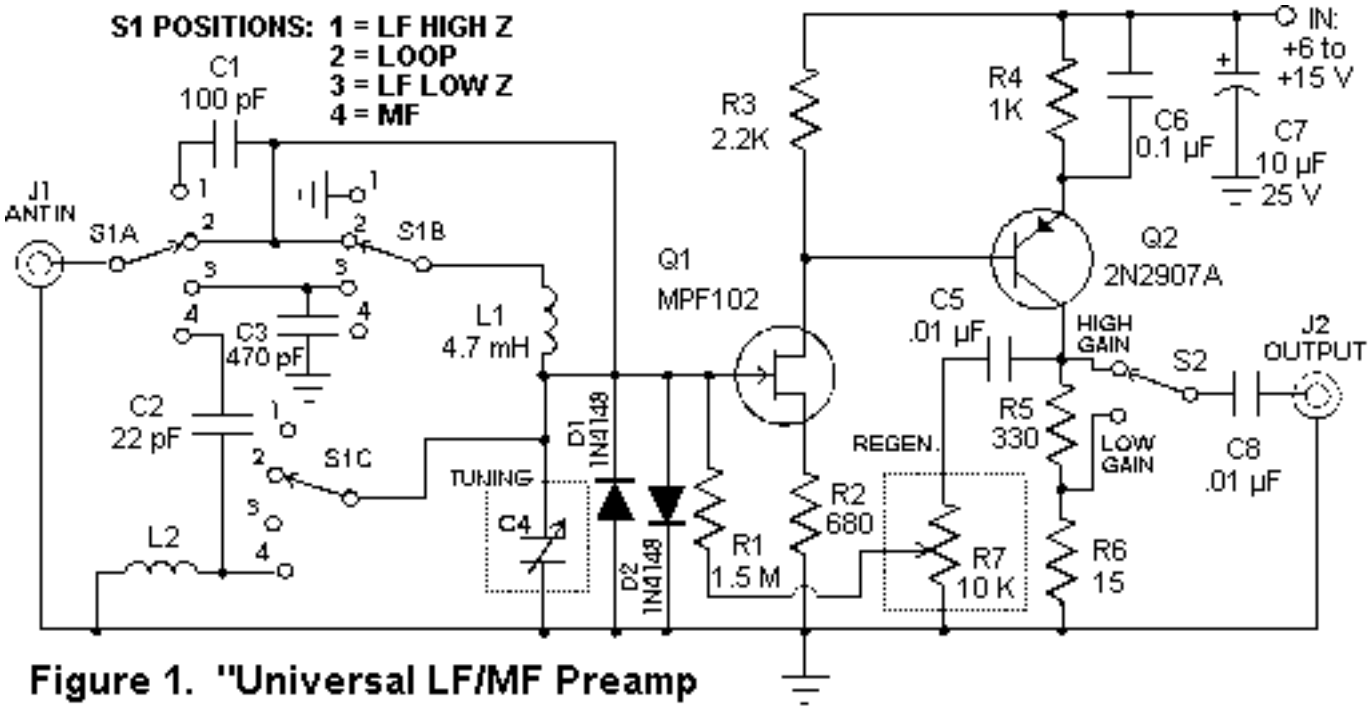


Figure 1. "Universal LF/MF Preamp

Additional parts information . . .

- L1: 4.7 millihenry (Mouser No. 434-17-472J or 434-06-472J)

- L2: 68 microhenry (32 turns #30 wire on FT-50-61 core or Mouser No. 43HH685)
- C4: 20-530 pF nominal (Mouser No. 24TR218; 2 sections connected in parallel) **See Addendum**
- S1: 3 pole 4 position switch (Mouser No. 10YX034)

Notes: The recommended part for C4 is a neat little capacitor but it comes without mounting screws or a knob. The best source for screws and a knob for this capacitor is an old AM transistor radio. Two options are shown for L1. Both have the same specified Q in the Mouser catalog, but the 434-17- series parts I've tested are somewhat better than the 434-06- parts. If you "roll your own" inductor L2 it will have a higher Q than the Mouser part. All of the other components are standard and their values are not critical.The Mouser Electronics toll-free number is 1-800-346-6873.

A four-position switch lets you select the input circuit that works best with your antenna. The "LOOP" position is for parallel-tuned loops fed with short lengths of coax. It will work at frequencies well beyond 10 MHz with a suitable loop (one that can resonate with C4). Using this circuit, I've heard IE on MF with a 7-inch long loopstick inside the shack, and have copied my own LF beacon in the daytime at over 250 miles with a 30-inch diameter, 22-turn loop. The "LF low Z" position works well with random-length wire or series-tuned loop antennas fed with long coax runs. Short whip antennas with short coax work best in the "LF high Z" position. An "MF" position is provided for use with MF antennas other than parallel-tuned loops.

Regeneration control is achieved by feeding part of the output signal back to the gate of Q1 through a variable attenuator and the gate resistor R1. This approach eliminates the need for feedback windings on L1 and L2, which would degrade the coil Q and complicate the switching. Another advantage of this circuit is that regeneration can be used with loop antennas without adding feedback windings. When regeneration is used, tuning becomes very sharp. A 20 or 30 pF fine tuning capacitor across C4 is recommended (if you can find one!).

This preamp has more gain than many receivers need. Switch S2 provides a way of attenuating the preamp output signal by about 20 dB, and a smaller value of R6 can be used if more attenuation is desired. S2 should be set to the "Low gain" position when regeneration is used. In fact, it may not be possible to reach the point of maximum usable regeneration (just before oscillation begins) with S2 in the "High gain" position.

Remote Control

Suggested circuits for remote tuning and regeneration control are shown in Figure 2. Parts with three-digit numbers are additional components needed for remote control. Single-digit part numbers refer to components previously identified in Figure 1. Remote tuning is accomplished by using a back-to-back pair of varactor diodes in place of C4. The maximum capacity of a pair of MVAM109s in series is only about 250 pF. If desired, C4 can be left in the circuit to extend the low end of the tuning range, or another pair of varactor diodes can be connected in parallel with D101 and D102. MVAM109s are available from DC Electronics at (800) 467-7736.

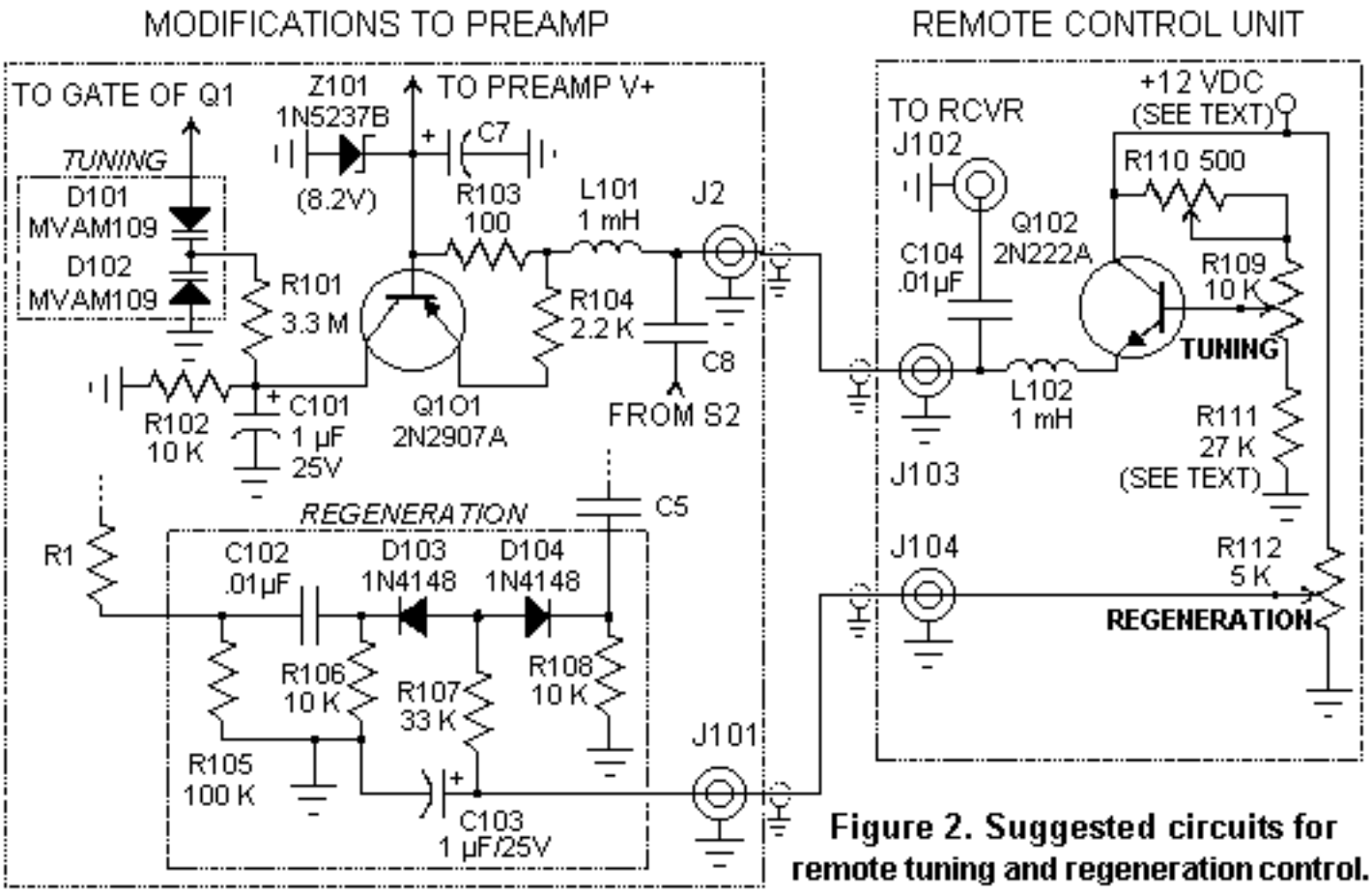


Figure 2. Suggested circuits for remote tuning and regeneration control.

If you want, you can run a multiple-conductor shielded cable between the control unit and preamp, and use separate wires for power, signal and tuning. (I've used 150 feet of ordinary audio cable in my field tests of the preamp with no significant loss of signal.) Separate wires let you use a much simpler remote tuning circuit. But that's too easy. Figure 2 shows how to make one shielded wire perform multiple tasks. Q101 functions as a DC amplifier with offset, so that the tuning voltage varies from zero to 9 volts while the voltage on J2 is varied from about 9 to 11.5 volts. RF chokes and blocking capacitors at each end of the line isolate the signal output from the DC supply/tuning voltage. With this circuit, a single coaxial line carries the power and tuning control voltage to the preamp, and brings the output signal back to the receiver.

The inductance values of L101 and L102 aren't critical, but they should each have a DC resistance less than 15 ohms. Some tweaking of the nominal 12 VDC supply voltage and/or the 27 K resistor (R111) may be needed to get the full tuning voltage range in your circuit. To check the circuit, connect a DC voltmeter between the collector of Q101 and ground. With the coarse tuning pot (R109) turned fully counter-clockwise, the voltmeter should read less than 0.5 volts. As you rotate the tuning pot, the voltmeter reading should begin to rise and should be close to 9 volts with the pot fully clockwise. Increasing the value of R111 will raise the minimum tuning voltage. Increasing the supply voltage will raise the tuning voltage at all settings of the tuning pot. The 500-ohm pot (R110) in Figure 2 is a "fine tuning" control. It can be omitted if you don't plan to use regeneration.

A diode attenuator circuit is used in place of R7 for remote regeneration control. Purists would use PIN diodes in the circuit, but 1N4148s work in this application. A separate wire is needed to carry the regeneration control signal. There's a practical limit for how much stuff we can do with one piece of coax. Actually, I haven't found that regeneration helps my LF reception -- certainly not enough to be worth the effort. In other environments, regeneration might offer some benefit, and it's hard to know unless you try it.

Performance

When using a long wire or large dipole antenna, it may be necessary to attenuate the input signal to prevent overloading and intermodulation. If you experience overloading from AM broadcast stations, use the LF low Z position with an additional capacitor (.01 UF or larger) in parallel with the antenna terminals. If you're being hammered by Loran-C pulses, try switching to the LF high Z position and putting a small capacitor (10 or 20 pF) in series with the antenna.

Thanks to Bruce, AAØYB and Sam, WØIMG for leaving their beacons on during the thunderstorm season so I could perform some actual listening tests on LowFER signals. Both of their transmitters are about 95 miles from me, which provides a reliable signal path when the QRN isn't overwhelming. Using either the circuit of Figure 1 or a preamp with the remote tuning options in Figure 2, BK and SAM came in very well on a homebrew LF receiver with any of three portable loops ranging from 30 inches to 48 inches in diameter. Signals were also readable on a Radio Shack DX-440 portable receiver with all of the loops, although the 30-inch loop is pretty marginal.

A 40-inch whip antenna mounted about four feet off the ground seemed to be nearly useless for LowFER reception. Extending the whip length to 11 feet brought the signals up to a readable level, but not to the QSO quality attainable with the larger loops. Maybe the whip would perform better on sky-wave signals.

Addendum

In January, 1997, Lyle reports on a complication with the variable capacitor:

Complaint department -- Mouser Electronics and Circuit Specialists have both discontinued the dual 266-pF variable capacitor used in the Universal Preamp. I don't know of any other supplier for this particular part. It's getting harder and harder to find an assured source of supply for variable capacitors.

---

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Return to Longwave Antennas and Receivers Library.

[HOME ICON] Go to Longwave Home Page.

Rap 'n Tap

Re: Tuned Loop For AM Radio

From: Harvey Harbicht
Date: 4/29/99
Time: 12:17:46 AM
Remote Name: 169.207.3.5

Comments

Just a couple comments.

1) What's the real difference between a "Tuned Loop" and a xtal set? The diode and earphones.

2) For a beautiful loop, take a 6 foot piece (I think it's 6 foot) of 16-conductor computer ribbon cable and connect the ends together offset by one.

1 - 2 -1 3 -2 4 - 3 . . . 16-15 - 16

Add the cap or whatever you want.

Now you have a nice one-piece portable loop that you can carry in your coat pocket or hang around a nice frame.

Not my idea. I'm just passing it on.

As for the soldering.....I'm searching the stores for two snap-on connectors. One male and one female. I'm going to put them on the ends of my cable and just plug them together offset by one. I HATE soldering!!!

Rap 'n Tap

A conveniant AM loop antenna

From: William Clarke
Date: 7/13/99
Time: 7:06:59 AM
Remote Name: 204.241.88.2

Comments

I have found this antenna to work well across the AM BCB in spite of being close wound, which is said to lower "Q" and lead to increased stray capacitance.

The form is a 14" embroidery hoop (like in the Joe Carr book) with 14 turns of 26 ga. enamel wire close wound on it. I wound a 2 turn coupling loop over the main loop to attach to the receiver. The main loop has a variable cap (the 365 pF kind from the XSS) across it for tuning. I have a small imported vernier dial attached - a valuable tuning aid. The outer(split)hoop is attached to small wood plaque base (where the cap is mounted) with a 6" long dowell rod. (The hoop, base, and dowell can be purchaced at a craft store like Michael's). The inner loop can be easily removed and replaced - like plug in coils for your antenna. (Get several hoops - they're cheap. A 10 turn space wound loop will work up to the 30 meter band.)

This antenna won't deliver the same power that a larger loop or long wire will, but it takes up a lot less space. It has good directional properties and is great for getting rid of noise. I can null out the attic fan with this thing.

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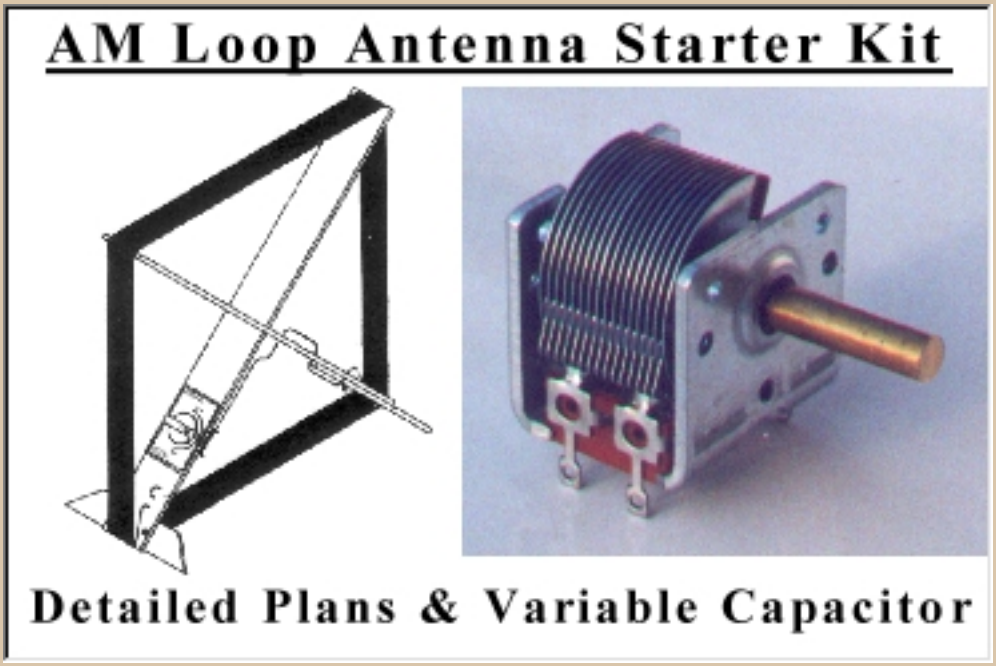

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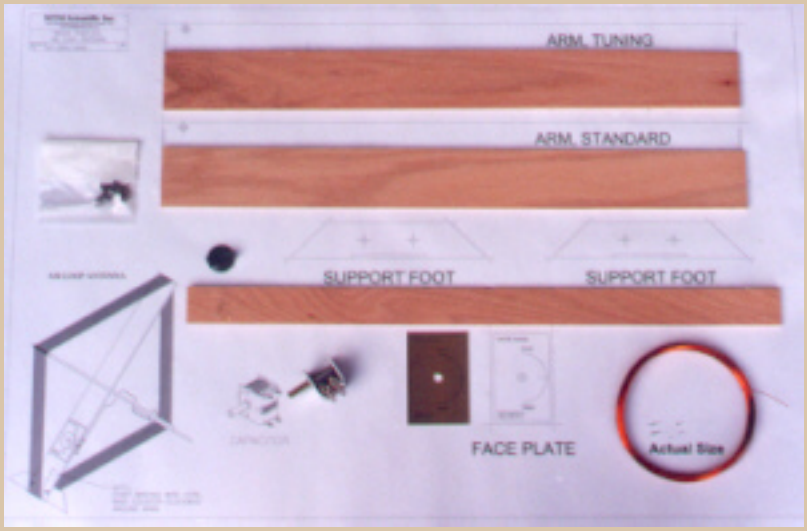

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All About Inductive Loops

The material below describes the technology and reported performance of Loop Detectors. The document is divided into the following sections:

- Principles and Theory of Operation
- Detector Configuration
- Selection Criteria
- Installation and Maintenance Considerations
- Attainable Information
- Data Reliability

Principles and Theory of Operation

Loop detectors operate on the principle of inductance, the property of a wire or circuit element to "induce" currents in isolated but adjacent conductive media. A detector consists of an insulated electrical wire, placed on or below the road surface, attached to a signal amplifier, a power source, and other electronics. Driving an alternating current (normal operating frequency between 10kHz and 200kHz) through the wire generates an electromagnetic field around the loop. Any conductor, such as the engine of a car, which passes through the field will absorb electromagnetic energy and simultaneously decrease the inductance and frequency of the loop. For most conventional installations, when the inductance or frequency changes a preset threshold in the actuate detector electronics, this indicates that a vehicle has been detected. Many factors determine loop inductance, including wire size, wire length, the number of turns, lead length, and insulation.

Detector Configuration

As noted above, the elements of a detector include:

- an inductive loop
- a pull box
- a lead-in cable
- a loop controller, which normally consists of a tuning network, a signal amplifier, a data accumulator and other detector electronics

The inductive loop is an insulated electrical wire, usually several meters to a side, with several turns. Loops are installed in a variety of shapes such as square, rectangle, diamond, circular and octagonal, though each configuration produces a different electromagnetic field. For instance, diamond loops reduce the probability of detecting vehicles in adjacent lanes. The pull-box, usually located adjacent to the road, houses the splices between the lead-in cable from the controller and the lead-in wires from the loop. Lead-in wires are usually shielded and twisted to eliminate disturbances from external electromagnetic fields, such as adjacent loops. The controller electronics, usually housed in a rugged cabinet in a safer more accessible location, detect, amplify, and process loop signals. The controller orchestrates loop operation and provides power. A typical controller can handle up to forty loops, though in practice will probably oversee far fewer.

Inductive loops may be placed either on the road surface, or up to twenty inches or more into the pavement. While deep buried loops exhibit a longer life span, their electromagnetic field is weaker and detection becomes more difficult . Loop sensitivity, defined as the smallest change in inductance which will cause actuation, decreases around 5% for every inch into the pavement the loop is installed. Since the characteristic shape of a detection is not distorted, additional loop turns which emit a stronger loop field can compensate for pavement interference. Unless loops are installed during road construction, installation requires a saw cut, up to 10 mm wide, into the pavement. Unfortunately saw cuts have been found to undermine the structural stability of the pavement in some cases.

Wire type also influences loop operation. Most inductive loops are formed by wrapping a single wire strand around the loop shape a prescribed number of times. Because these turns are spaced randomly, the electromagnetic field, and consequently detection results may vary from detector to detector. It has been established that a multi-conductor cable, which holds the loops in uniform proximity, will produce more accurate measurements. Installation of the multi-conductor necessitates a wider cut into the pavement than the single wire configuration. Ruggedized, weather resistant pre-formed loops are available which aid in uniformity, but also can be more difficult to install.

Detectors operate in either the pulse or presence mode. Presence operation, often used with traffic signals, implies that detector output will remain "on" while a vehicle is over the loop. Pulsed detection requires the detector to generate a short pulse (e.g. 100 to 150 ms) every time a vehicle enters the loop, regardless of the actual departure of the detected vehicle.

Many detectors today employ digital technologies which sense a change in the resonant frequency of a loop due to a decrease in inductance. Digital techniques allow more reliable and precise measurements than their analog counterparts. Some digital units incorporate advanced electronics such as self-tuning amplifiers, open-loop test functions, and automatic or remote reset capabilities. These features can significantly reduce detector maintenance costs and calls. The newest detectors can actually output the digitally sampled inductance "signature" of each vehicle, allowing the development of flexible signal processing software to add considerable more robustness than the hardwired set "threshold" detectors.

Selection Criteria

Several parameters characterize the performance of loop detectors:

Response Time

Defined as the time between the when inductance crosses the preset "threshold" due to the arrival or departure of a vehicle, and when this is indicated on the digital output side of the detector. A consistent and fast response time is crucial for accurate speed measurements. Response time is affected by vehicle size, speed, detector type, sensitivity, and wire type. Response time decreases with smaller vehicles, which have lower ground clearance and a shorter distance to the engine block and axle. Faster speeds tend to reduce response time, as does increased sensitivity.

Recovery Time

The time required for a loop to return to normal operation after a period of sustained occupancy. Recovery time is particularly important for vehicle counting. Loop standards dictate that after a sustained occupancy of five minutes a detector return to at least 90% of the minimum sensitivity within one second after the zone of detection is vacated.

Installation and Maintenance Considerations

For comprehensive surveillance of mainline routes, detector stations (possibly pairs) should be installed every 600 to 1200 meters. Loops should also be stationed around access and egress points, and at any locations where operational problems occur. Provisions should also be made for maintenance access. Different degrees of processing of raw loop data may be performed at the TMC or remotely in the field. Remote analysis requires additional processing hardware for each detector station, but less sophisticated communication links, since only the data relevant to highway surveillance is transmitted back to the TMC. In contrast, centralized analysis requires the transmission of large quantities of raw data and greater hardware requirements (storage and processing) at the TMC. If transmission lines are leased, which is often the case, data transmission costs can become cost prohibitive.

Annual maintenance costs average around 10% of the original installation and capital cost, adjusted for inflation.

Loop failure rates are strongly related to maintenance and installation procedures. Surveys of state DOTs indicate that failure rates vary significantly, ranging anywhere from three to fifteen percent per year. In practice, loop inspection procedures also vary substantially among DOTs. Loops may be inspected anywhere from one to twenty-five times per year. Highest inspection rates occur where loop operation is critical to the operation of other deployed traffic management systems. In many instances loop maintenance costs are sufficiently high that malfunctioning loops are replaced outright, without any diagnosis of the cause of failure. Because loops have been deployed extensively, consistent installation recommendations and primary causes of loop failure have been documented.

Installation

Installation recommendations for effective and long lasting loop systems include:

- installation and calibration should as uniform as possible.
- saw cuts should be cleaned out and dried before loop installation. Saw cuts should also be of uniform depth.
- Loops should be properly sealed.
- detectors should feed off the same power supply.

Mechanical Failure

Many factors contribute to physical loop failure. Pavement and sealant (of the saw cut) failure are commonly identified as the primary culprits. Pavement failure or deformation (cracking, rutting, potholes, or shoving) causes loop wires to be strained resulting in breakage, wire insulation wear, or the infiltration of foreign materials. Sharp bends in loop corners have also been found to cause problems, such that the insulation deteriorated or was broken.

Sealant failure poses additional problems. Once the sealant fails, the loop may become exposed or foreign materials may infiltrate the cut. In many cases the loop was found to have floated to the top of the cut, either before the sealant could cure or because it remained plastic. Other common sources of loop failure include poor installation and maintenance procedures, damage from utility repair or construction, lightning surges, detuned amplifiers, and corroded splices or wires.

Data Malfunction

Many sources of loop malfunction can produce erroneous detector data. These include stuck sensors, hanging (on or off), chattering, cross-talk, pulse breakup, and intermittent malfunction. Cross-talk involves the mutual coupling of magnetic fields that produces interaction between two or more detector units which are in the same cabinet or in close proximity to each other. Cross-talk results in erratic loop behavior and inaccurate detections. Pulse break-up involves gaps in detector actuation data, which may be incorrectly interpreted as different vehicles. As described below, many of the these problems can be corrected with data filters.

Attainable Information

Loop detectors supply several pieces of information about prevailing traffic conditions, including vehicle presence, flow, occupancy, and velocity. A good loop detector system is cited as accurate to within 5%. The accuracy and consistency of detector output is a strong function of installation and calibration procedures. For example, it is possible that detectors with different sensitivities longitudinally separated by thirty feet give occupancy data which differs by 40%. Loop detectors are also limited by their inability to detect stationary vehicles.

Flow and occupancy may be extracted directly from loop data. Speed may be approximated from the data of a single detector using the fundamental theory of traffic flow:

$$\text{flow} = \text{speed} * \text{density}$$

where density is approximated from occupancy by:

$$\text{density} = \text{occupancy} * g$$

and

$$g = \frac{K}{(\text{vehicle length} + \text{detector length})}$$

where K is a conversion factor. While it is possible to obtain reasonable speed estimates with this strategy, paired loops offer a more accurate approach. Velocity is calculated from the travel time between two loop detectors which are separated by a known distance. Accurately calibrated speed traps with loops of individual wire can expect to achieve measurement errors of 5-8 kph (3-5 mph) at low speeds and 16-19 kph (10-12 mph) at high speeds. Multi-conductor cable loops average errors about 0.3 kph (0.2 mph) at low speeds and 5-8 kph (3-5 mph) at high speeds.

There are several considerations in speed trap design. For one, loop inductance is a strong function of vehicle speed. One study determined that a vehicle travelling at 20 mph produced a 3% inductance shift, while another at 80 mph yielded only a 1% inductance shift. Sensitivity settings may have to be adjusted when ILDs are used in high-speed freeway environments. The separation between loops is another relevant variable. In practice anywhere from 2 meters to more than 20 meters is feasible. However if detectors are too close cross-talk may occur, while detectors spaced too far apart may be susceptible to vehicle lane changes. Suggested optimal spacing is around 9m.

Data Reliability

For traffic management strategies such as incident detection to be effective loop data must be reliable and accurate. Many TMCs use a combination of manual inspection and reliability tests to validate incoming data. Such tests serve a dual purpose, they flag erroneous data and identify malfunctioning loops. Various approaches are employed to identify inaccurate data.

Initial error detection often occurs in the field. The data may be filtered, where pulses or gaps in actuation less than some brief interval, say one-fifteenth of a second, are ignored. The data may be flagged as unreliable if a microprocessor sees more than two valid pulses

(vehicle endings) in a second. These tests usually detect gross errors, but other malfunctions may go unnoticed.

More advanced filtering techniques are available to validate loop data. One approach is to compare a detector's on time to the average on-time of all other detectors at that station. A second strategy compares detector data (volume, occupancy, and speed) against realistic thresholds at periodic time intervals. For example, detector data is flagged if occupancy exceeds a predefined maximum for a certain period of time (say more than 90% for five minutes). A more complex algorithm uses a multi-regime comparison of the flow - occupancy ratio to maximum and minimum expected speeds. Occupancy is converted to density using a variable g which varies as function of occupancy. Research has shown that a constant g can introduce significant error into speed estimates. These algorithms achieve good detection rates with low false alarms rates, and often identify malfunctioning detectors overlooked by manual inspection. In practice most TMCs operate in a hybrid fashion, using several elements from the tests described above.

New detector cards which are becoming commercially available can directly output the (digitally sampled) change in inductance. This allows the development of analysis software with considerable more robustness. For example, conventional "threshold" detectors may double (or even triple) count a long truck with many distinct changes in inductive mass. Conventional detectors may double count a vehicle changing lanes between loops, or not count them at all, depending on how sensitive each lane's "threshold" is set. If the base inductance of a loop changes due to mechanical wear or weather induced corrosion, these old threshold detectors must be manually re-calibrated in the filed. With the new cards, it appears plausible to develop software to mitigate these types of problems by intelligently interpreting any and all changes in inductance across all the roadway loops at one time. Unfortunately, this capability has not been operationally proven in this country at this time (as of early 1997).

Sales
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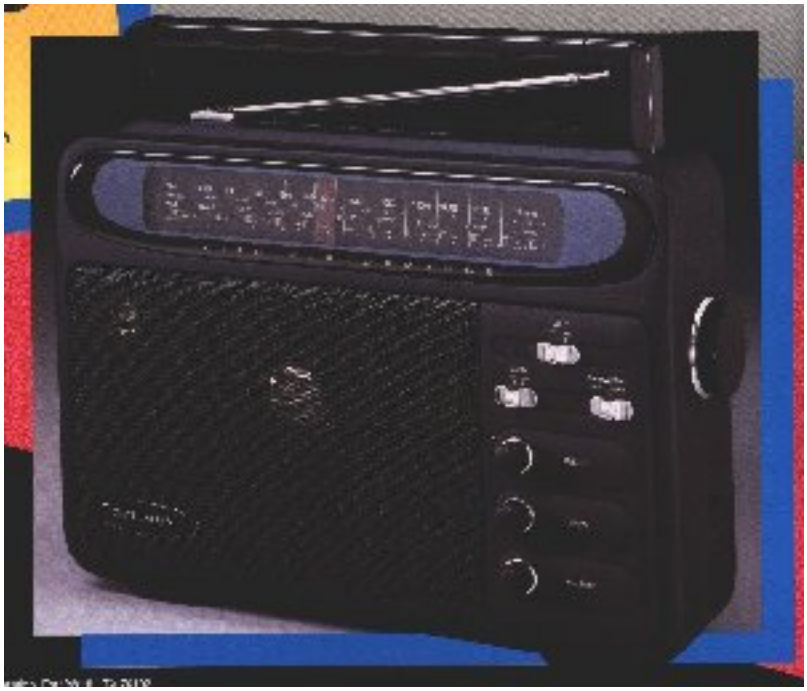
UPDATE! Radio Shack has discontinued the 12-603. It has been replaced by the model 12-903. Perhaps the problems described here with the 12-603 have been corrected on the new model - if Radio Shack provides me with an evaluation unit, I will be happy to review it for inclusion in this article. But $60 is a bit expensive for me - to go buy one just for this article. You can buy a Superadio III (GE 7-2887) from Amazon.com for about $40.

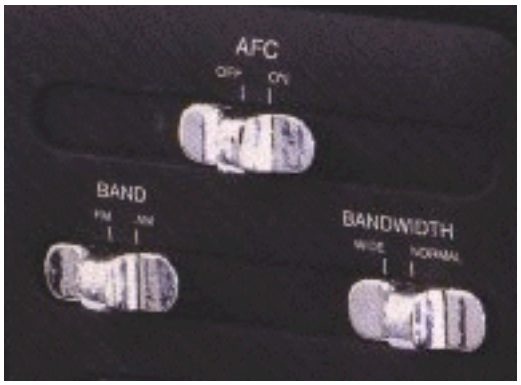
Is the Radio Shack Optimus 12-603 the Same as a GE SR 3?



Click on the image above to see an enlarged view ----

Because of the similarity of features and appearance, a lot of people have asked the question above. I am in a position to answer this question, because I own one of each unit. This page is a work in progress, as I had to do a very quick, clandestine analysis. My wife has little understanding of my desire to take apart everything brand new, and "perfectly good". Particularly when it is going to be a Christmas gift for my daughter, her first radio. I had an hour and a half to work on this project before I was in danger of discovery!

The answer to the question is a qualified "NO". The first clue that I had that the two radios were not identical was obvious even in the store. The arrangement of the secondary controls: "AM/FM", "wide/narrow", and "AFC" is different on the SR-3 and the 12-603:



After doing hardware hacking since I was in seventh grade, I knew that the underlying switches would most likely be soldered onto the PC board, rather than connected with wires. This strongly implied that the circuit board layout is different between the two units. This proved to be the case (see below).

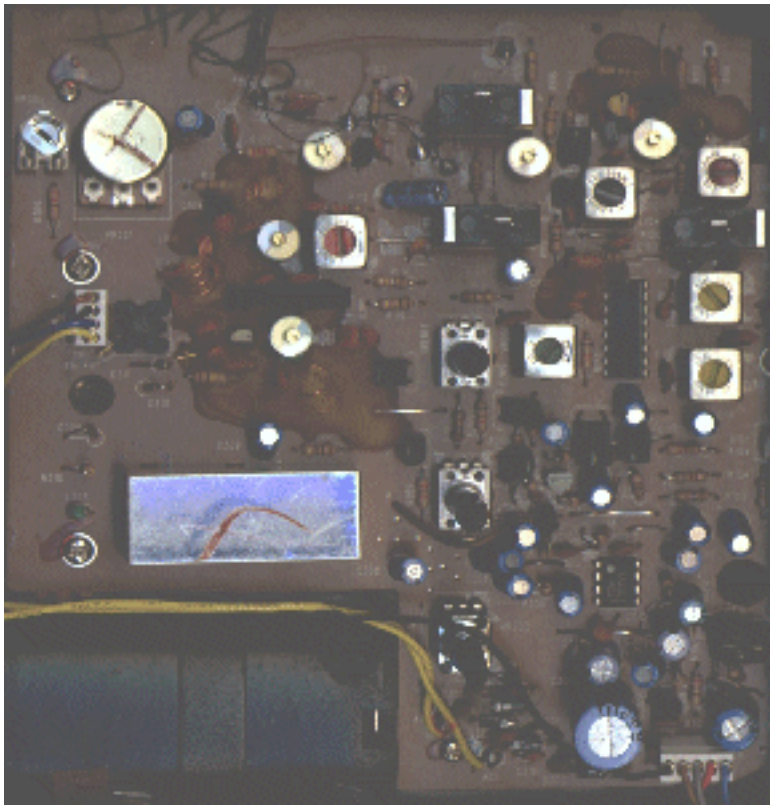
One thing that initially caused me to think I had purchased a defective unit: unlike the GE SR-3, the 12-603 includes an "AC/DC" switch on the back. Initially set to the AC position, the switch prevented me from using the radio with batteries (to minimize AC line noise that would enter the unit if I used the AC cord). When switched to the DC position, the radio worked with batteries. This may cause confusion to the user on occasion, resulting in drained / leaking batteries when the radio was supposedly on AC power. One other note related to this switch - it has one of those little dust shields that goes around the shaft inside the radio. I had re-assembled the unit only to find the dust shield sitting on the bench. I then had to take it apart so I could install it, since it will be used by an active child. Of course, after installing the batteries so it would work on Christmas day, I took advantage of the AC/DC switch to insure that the radio would only come on when the package was opened, and not if the box was hit on the switch, draining the batteries before Christmas. So maybe the switch is a good thing after all.

Actually, the Optimus radio is built better than the GE, using thicker, more rugged plastic - reminiscant of the GE SR-2, which I also own. I found myself grateful to Radio Shack for that, as it will be used by an active child. I am getting pretty good at quickly opening Radio Shack radios, after owning several. The front and side knobs should be removed, including the switch latches (unlike the SR-3, where they are underneath the cover). There are six long chassis screws, three on each side, and one short one in the battery compartment. It is not necessary to remove the screws holding the handle.

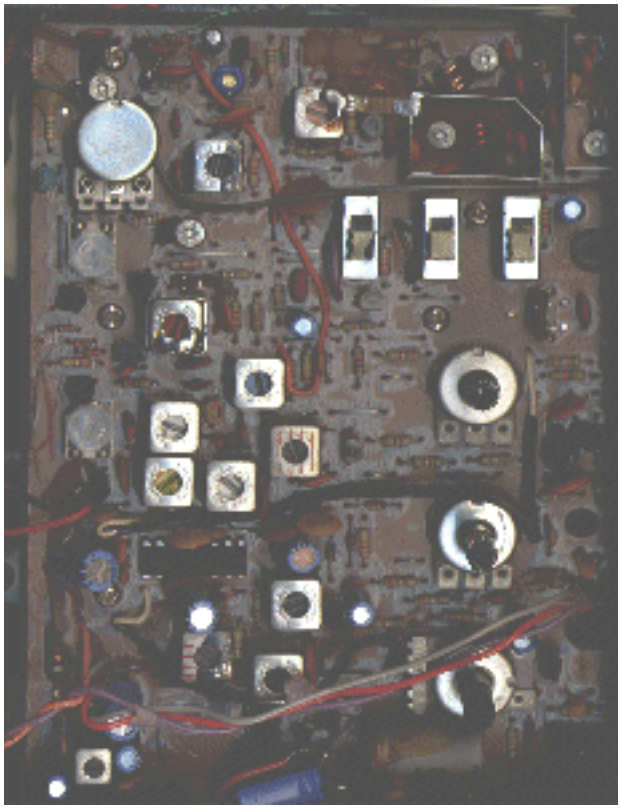
This is where it gets a little complicated, Radio Shack radios are notorious for needing a little dexterity and having "tricks" to opening. The case separates at the bottom, and it is necessary

to flex the earphone jack side outward a little to clear the earphone jack. Immediately afterwards, the two halves should be manipulated to minimize stress on the on/off switch, located on the top of the unit. After that, the two chassis halves can be separated - and you have access to the inner chassis.

A visual inspection revealed that the 12-603 circuit board is completely different from the SR3:



Optimus 12-603 circuit board



GE SR-3 circuit board

Click on either image to get a much larger version, that may be good enough for component identification.

I try very hard not to jump to the "more stuff is better" conclusion - which led me to buy a junky "12 transistor" Jade brand radio in 7th grade, when I should have bought Radio Shack's 8 transistor tuned RF radio instead. But what I see here is many more IF/RF cans on the GE radio, along with many other components. The 12-603 board is open by comparison, but there is a small screened area that could pack a lot of sensitive components inside. There is also one less adjustment in the FM front end, which I will discuss later.

Since the majority of DX'ers will be tempted to purchase the unit for AM reception, I thought that I would concentrate on that aspect. I had been forewarned of the smaller ferrite bar in the 12-603. It is 120 mm instead of 200. This is the United States, this old engineer still thinks of inches instead of mm. So the SR3 has a 7 7/8 inch rod and the 12-603 has a 4 3/4. As almost all of you will know, longer is better - as the ferrite is the only thing that can concentrate flux into the tiny loop antenna. The longer and thicker the rod, the more magnetic flux from the station is transferred to the loop - and the more distant the station that can be received. I have always thought the GE SR3 rod is a bit short for the size of the case. I have a small supply of 10 inch rods. Sadly, I broke my 12 inch rod many years ago. I would have installed a ten inch rod long ago, except the loop diameter is different. I noticed that although Radio Shack retained the loop diameter, they did not use the same quality of loop that GE did. They also omitted the second loop on the opposite end of the rod for external antenna coupling. It made me wonder what the

exteral AM antenna screw connected to inside the unit - a subject of further exploration when and if I get the opportunity. Naturally, the shorter ferrite rod made the unit's performance suffer greatly compared to the SR-3. There was no point doing a station-by-station comparison, there is simply no competition. A good example is the experimental "traveller's information radio" on 1680 kHz in the Orlando area. A very weak signal on the SR-3, but receivable, it did not even come in at all on the 12-603. Neither did a 530 kHz station from Cuba on the other end of the dial.

FM performance could not be measured directly. I am in a very difficult reception area. Many good stations are crowded onto adjacent channels with stronger stations. That is one reason why I purchased the 12-603. I hoped that it would allow my daughter to hear her beloved Z88, which is intentionally jammed by a mean, spiteful church down the road that insisted on putting a station on an adjacent frequency. This will not be the case, although I will not return the radio just because it is not a good FM performer. The FM performance of the SR-3 is also lackluster. Even if the 12-603 were up to SR-3 standards, it would be asking a lot of manual dexterity and tuning skill from a little girl to reject the garbage from down the street and get Z-88 instead.

The primary reason I could not make direct FM comparisons, however, is that I tend to swap out the 280 kHz ceramic filters provided in most radios with 150 kHz ceramic filters, which dramatically improves selectivity and sensitivity. My SR-3 is no exeception. It has a 150 kHz filter in it. I initially planned to do put a 150 kHz filter in the 12-603 so I could make direct comparisons, but it would involve a lot of assembly work, including re-stringing the dial, to get to the back of the circuit board. The other option would be diking the part from the top and cleaning the leads, but that usually entails a risk that you will have to get to the back of the board anyway. I did not have the time - maybe at some future date. I did find a station that was away from strong local signals - and I could make some sensitivity comparisons. I found that the 12-603 brought the station in loud and clear, the same as the SR-3. Another station, however, was not brought in as well.

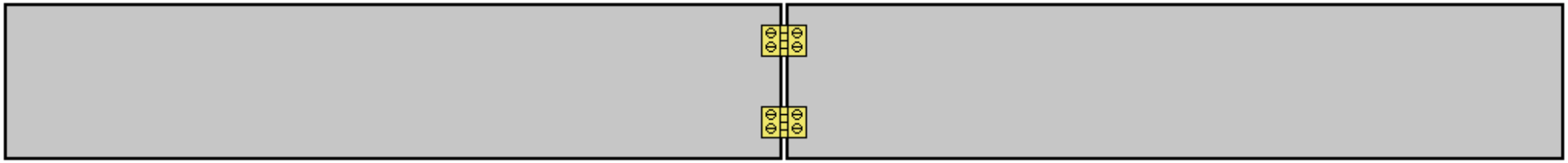
The next aspect of the question I investigated was the comment that the 12-603 comes poorly aligned, and alignment can improve its performance. I learned many years ago to do "coils low, caps high", and that the tuning dial low and high could be set with the oscillator coil and cap. I don't generally touch FM air coils in wax - too touchy and cranky. The 12-603 has no AM coils for low, so I had to be content with "caps high". I found that the RF cap was slightly off, but the antenna cap was very far off, about 30 degrees brought a dramatic improvement. The AM IF's (3) were slightly off. When touched up, performance improved slightly. Not enough to come anywhere near to the SR-3, or even bring in the weak 1680 kHz station. But enough to increase the volume on a weaker station around 1540 kHz, and bring in a faint signal on the 530 kHz station from Cuba. FM alignment did not yield much improvement, but some. It was closer initially to being correct. I found myself wondering why there was no FM antenna cap, and what sort of improvement it would yield if present. After all, the AM antenna cap yielded the most AM improvement. I am still very interested in seeing what happens when I put in 150 kHz cermic

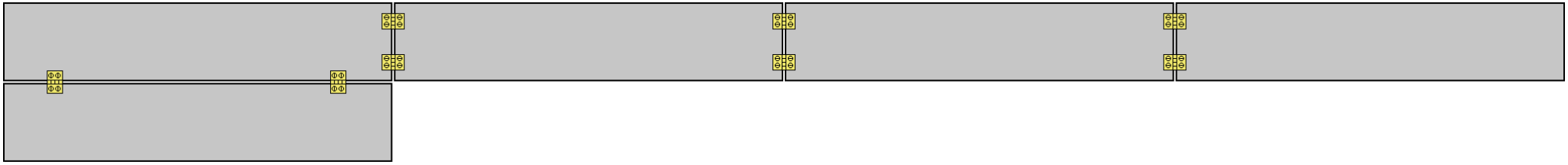
filters. Based on memory alone, I think the SR-3 was originally pretty poor as well. If Radio Shack stayed true to form, they put their efforts into FM and skimped on AM. "Stay tuned", but this is a hobby. It may be while before I try --- But if my daugher whines about Z-88, you can bet I will be doing it quick!

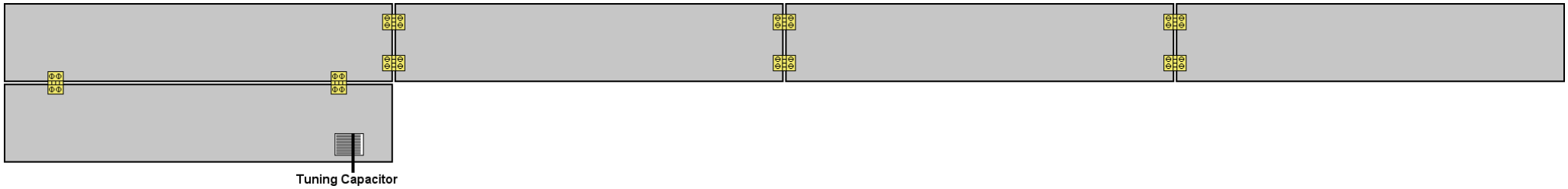
So - the bottom line is - NO, if you are looking for a DX unit "out of the box", and do not want to spend time tinkering. Go to the trouble of finding a genuine SR-3. It is also the latest in a long line of radios that prove that Radio Shack is not really interested in marketing a true AM DX unit to the consumer. In crucial areas like the ferrite bar, they skimp to save money. The concentrate instead on FM, and on the case and exterior.

If you are willing to tinker, use an external antenna, swap out ceramic filters, etc - the jury is still out. It is NOT a re-packaged SR-3 circuit board. It is a totally unique, different design. The potential may or may not be there. In any case, do not buy this unit to DX FM. The SR-2 is a much better portable unit, but any number of car radios, operated off of 9 "D" cells, will give you better portable FM DX.

The 12-603 is still a solid performer, better than standard stuff you can get elsewhere, and worth the sale price of $40. It will be a good introduction to the world of DX'ing to my daughter - to whom every and any distant station logged will be a new marvel.



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